U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-270 082

Inspection Manual for Secondary Brass and Bronze Smelters

Engineering-Science, Inc, McLean, Va

Prepared for

Environmental Protection Agency, Washington, D C Div of Stationary Source Enforcement

Jan 77

EPA 340/1-77-003
JANUARY 1977

PB 270 083

Stationary Source Enforcement Series

INSPECTION MANUAL FOR ENFORCEMENT OF NEW SOURCE PERFORMANCE STANDARDS

SECONDARY BRASS AND BRONZE INGOT PRODUCTION PLANTS

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement
Office of General Enforcement
Washington, D.C. 20460

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NATIONAL TECHNICAL
INFORMATION SERVICE

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-340/1-77-003	2.
4. TITLE AND SUBTITLE: Inspection Manual for Secondary Brass and Bronze Smelters	5. REPORT DATE: February 1977
7. AUTHOR(S): H. D. High, V. A. Li Puma, H. E. Lukey	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Engineering-Science, Inc., 7903 Westpark Drive, McLean, Virginia 22101	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO. 68-02-1086
12. SPONSORING AGENCY NAME AND ADDRESS: Environmental Protection Agency, Division of Stationary Source Enforcement, Washington, D.C.	13. TYPE OF REPORT & PERIOD COVERED: Final
	14. SPONSORING AGENCY CODE: 140/03

15. SUPPLEMENTARY NOTES

One of a series of NSPS Enforcement Inspection Manuals

16. ABSTRACT

This document presents guidelines to enable enforcement personnel to determine whether new or modified secondary brass and bronze smelters comply with New Source Performance Standards (NSPS). Key parameters identified during the performance test are used as a comparative base during subsequent inspections to determine the facility's compliance status. The secondary brass and bronze smelter process, atmospheric emissions from this process, and emission control methods are described. Inspection methods and types of records to be kept are discussed in detail.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Smelters Air Pollution	Copper Smelters	13B 14G 11F

18. DISTRIBUTION STATEMENT: Release unlimited	19. SECURITY CLASS (This Report): Unclassified	21. NO. OF PAGES: 89
	20. SECURITY CLASS (This Page): Unclassified	22. PRICE: PC $5.45 MF A01

EPA Form 2220-1 (9-73)

INSPECTION MANUAL FOR ENFORCEMENT OF NEW SOURCE PERFORMANCE STANDARDS: SECONDARY BRASS AND BRONZE INGOT PRODUCTION PLANTS

Contract No. 68-02-1066

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U. S. ENVIRONMENTAL PROTECTION AGENCY
Division of Stationary Source Enforcement
Washington, D. C.

January 1977

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ACKNOWLEDGMENT

This report was prepared under the direction of Mr. Terrance A. Li Puma, Manager of the Air Pollution Control Department of Engineering-Science, Inc. The principal author was Michael E. Lukey. The Technical Director and Editor of the manual was N. Dean High, Vice President of Engineering-Science, Inc.

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1.0 INTRODUCTION

In accordance with Section 111 of the Clean Air Act, the Administrator of the Environmental Protection Agency promulgated particulate and opacity standards of performance for new and modified secondary brass and bronze ingot production plants. The standards became effective March 8, 1974 and apply to sources the construction or modification of which was commenced after June 11, 1973. The standards are applicable to reverberatory and electric furnaces with a production capacity of 1,000 kg (2,205 lb) or greater and blast (cupola) furnaces with a production capacity of 250 kg/hr (550 lb/hr) or greater.

Under these new source performance standards, a performance test must be conducted on any new or modified secondary brass and bronze ingot production plant to ensure that control equipment is designed and installed which will provide compliance with the standard. After determining that the facility with its control equipment does, in fact, comply with the standards, it is the further intent of the regulations that the equipment not be allowed to deteriorate to the point where the standards are no longer maintained. A specific provision, 60.11 (d), provides that affected facilities shall be operated and maintained "in a manner consistent with good air pollution control practice for minimizing emissions."

The purpose of this manual, therefore, was to provide the air pollution inspector with necessary information so that he could determine whether or not an ingot plant was still in compliance for some period of time after the conduct of initial performance tests. To provide for this continuing enforcement of the emission standards, the Division of Stationary Source Enforcement of the Environmental Protection Agency anticipated the need for a series of field inspection manuals which could be used by an air pollution control official to assist him in determining whether a pollution source was complying with all applicable regulations. While this manual was developed primarily to meet the need for enforcement of EPA's new source performance standards, it was intended that the information contained herein would be equally useful for enforcement of state regulations applicable to all existing brass and bronze facilities.

In both cases the regulations may be enforced by either Federal or State air pollution control authorities. Each state may develop a program for enforcing the Federal new source performance standards applicable to sources within its boundaries. If the proposed program is adequate, EPA will delegate implementation and enforcement authority to the state for all affected sources with the exception of those owned by the U.S. Government. Also, each state was required to submit implementation plans to EPA in 1971 that included emission regulations which would reduce emissions and ensure attainment and maintenance of the ambient air quality standards (Section 110 of the Clean Air Act). If the regulations are not enforced at the state level, then EPA is legally obligated to enforce the State's Implementation Plan. If a Federal inspector observes a violation of a state's regulation adopted under the State Implementation Plan, he can co-equally enforce the SIP regulation.

The scope of this manual includes all processes normally found in the secondary brass and bronze smelting and refining industry. It should be equally applicable to both existing and new facilities. It does not cover primary copper smelters which use ore concentrates as their copper source.

This report was prepared from information previously published on the brass and bronze industry, from stack tests of several brass and bronze plants, from applicable rules and regulations promulgated by EPA and published in the Federal Register, and from past experiences of the air pollution control staff of Engineering-Science, Inc. The assistance of staff from the Division of Stationary Source Enforcement was particularly helpful in providing direction for the project.

2.0 NSPS AND SIP REQUIREMENTS

2.1 NEW SOURCES--NSPS

The Federal Emission Regulations applicable to new brass and bronze industry sources are called New Source Performance Standards (NSPS). They are published in the Code of Federal Regulations under Title 40 CFR Part 60. The standards require control at a level typical of a well controlled existing plant and are attainable with existing technology. To determine the emission level which should be selected as the standard, extensive on-site investigations were conducted and design factors, maintenance practices, available test data, and the character of stack emissions were considered. Economic analyses were also conducted prior to promulgating the standards. An EPA document which provides background information on the derivation of the standards is entitled, "Background Information For Proposed New Source Performance Standards."(4)

Provisions of the regulation are applicable to reverberatory and electric furnaces of 1000 kg (2,205 lb) or greater production capacity per heat and continuous blast (cupola) furnaces of 250 kg/hr (550 lb/hr) or greater production capacity. To eliminate repeated reference to the Federal Register, the definitions and standards are paraphrased in the ensuing discussion. Reverberatory furnaces include stationary, rotating, rocking, and tilting types. An electric furnace is one that uses electricity to produce over 50 percent of the required heat. A blast furnace is any furnace used to recover metal from slag.

On and after the date on which the performance test required to be conducted by paragraph 60.8 is initiated but no later than 180 days after initial startup, no owner or operator subject to the provisions of the regulations shall discharge or cause the discharge into the atmosphere from a reverberatory furnace any gases which:

- Contain particulate matter in excess of 50 mg/dscm (0.022 gr/dscf); or
- Exhibit 20 percent opacity or greater.

Likewise, after a performance test has been conducted, the effluent gases from any blast furnace (cupola) or electric furnace shall not exhibit 10 percent opacity or greater.

The opacity standards exclude uncombined water vapor. No mass standard was proposed for electric and blast furnaces primarily because (1) 95 percent of the production is carried out in reverberatory furnaces and (2) the visible emission standard is an adequate enforcement criterion and can be met only by well controlled units.

2.2 EXISTING SOURCES--SIP

Under the 1970 Clean Air Act amendments, each state in 1971 had to file with EPA a State Implementation Plan (SIP) which included emission regulations to achieve and maintain ambient air quality standards. EPA encouraged some uniformity and reasonable stringency of the standards by publishing suggested standards as Appendix B of a regulation on preparation of State Implementation Plans. (6) In the case of particulate emissions, EPA published a reference process weight table (Table 2.1) representative of data from state and local regulations.

The Federal standard is stated with respect to grain loading in the emitted gas while the state standards are generally stated with respect to the mass emissions from the process. However, no state or local agency now has an emission standard specifically for the brass and bronze industry. Instead, process weight regulations are commonly employed by many state and local jurisdictions to limit particulate emissions from a variety of industrial sources. However, the actual limits vary from state to state so Table 2.1 should be considered illustrative only and should not be referenced for enforcement purposes. Furthermore, state regulations are frequently modified and may contain qualifications, exceptions or special provisions for certain source categories.

By definition, process weight per hour means "the total weight of all materials introduced into a special process that may cause any emissions of particulate matter" to the atmosphere. In some industries this definition of process weight is somewhat complicated. In the secondary brass and bronze industry, however, the process weight refers to the amount of charge fed to the furnace and these quantities are normally recorded in the operator's daily log for each furnace.

Table 3.1 REPRESENTATIVE DATA FROM PROCESS WEIGHT CURVE

Process weight rate, lb/hr	Allocable emission rate, lb/hr
50	0.36
100	0.55
500	1.53
1,000	2.25
5,000	6.34
10,000	9.73
20,000	14.99
60,000	29.60
80,000	31.19
120,000	33.28
160,000	34.85
200,000	36.11
400,000	40.35
1,000,000	46.72

The equivalent concentration restrictions that now appear in process weight tables limit emissions to between 0.05 and 0.3 gr/scf. Some regulations, by definition of particulate matter, do include material collected in the wet impingers thus making compliance more difficult. Wet impingers use high velocity impingement in water thereby increasing the amount of particulate matter caught. In general, the NSPS of 0.022 gr/dscf is more restrictive than any process weight curve for furnaces of the size used in the brass and bronze industry. Specifically, the NSPS will limit emissions to between 1.0 and 1.5 lb/hr whereas a typical 25-ton brass furnace (24-hour cycle) would be allowed 3.6 lb/hr under the process weight table shown above. For a typical blast furnace rated at 50 tons/day (production output) with an exhaust gas flow rate of 15,000 dscfm, the New Source Performance Standards (NSPS) will allow the furnace to emit 2.8 lb/hr of particulate matter. By comparison, the reference process weight regulation (see Table 3.1) for that size blast furnace (83 tons/day, or 6,900 lbs/hr charge rate) would limit particulate emissions to only 7.6 lb/hr.

Therefore, state and local regulations are less stringent than the NSPS for blast and reverberatory furnaces. The most stringent of the state and local standards restrict particulate emissions of 20- to 60-ton furnaces to 4 to 8 lb/hr, which corresponds to 0.02 to 0.08 gr/dscf (assuming exhaust gas flow rates of 12,000 to 24,000 dscfm). Some of these standards are based on particulate sampling methods that differ from the EPA technique in that they include material collected in wet impingers. Where such testing methods are specified the impinger particulate catch may account for anywhere from 5 to 90 percent of the total particulate caught in the source testing train.

The opacity regulations of most states apply to all point sources regardless of whether the emission is discharged from a stack. Opacity limitations in some states may apply to fugitive dust sources.

2.3 APPLICABILITY OF STANDARDS

The New Source Performance Standards apply only to the three major types of furnaces used in the brass and bronze industry--reverberatory, electric, and blast. The standards do not apply to very small furnaces--below the indicated cut-off size but such small furnaces will not often be encountered. The standards apply after the new facility has been started up and reached some degree of equilibrium. For the first performance test, the owner must give 30 days advance notice to the Administrator of EPA. The standards are not applicable during startup, shutdown and malfunction since these periods do not constitute representative operating conditions. However, as will be described later, the owner must report all excess emissions on a quarterly basis. Also the regulations ensure that plant operators properly maintain and operate the affected facility and control equipment between performance tests including the periods of startup, shutdown and unavoidable malfunction.

One of the more difficult subject areas to determine is the applicability of the standards to existing sources which undergo modification. Under the revised regulations the definition of affected facility is limited to an apparatus to which a standard applies. "Modification" means any physical change in, or change in the method of operation of, an existing facility which increases the amount of any air pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of any air pollutant (to which a standard applied) into the atmosphere not previously emitted. The definition of modification and other questions of applicability are fully discussed at 40 FR 58416 (December 16, 1975).

The proper application of opacity regulations is difficult when effluent plumes from sources subject to different opacity regulations are combined. Such a situation will occur with some frequency in the secondary lead smelting industry when existing and new sources, or several different types of new sources are combined to a single control device. To test for opacity and mass emission compliance during a new source performance test it may be necessary to utilize only that percentage of baghouse capacity which a new source will use. At other times, emissions in violation of NSPS opacity regulations but below SIP or applicable local regulations will have to be verified as caused by NSPS covered process or control. Inspection of plant operations records should show which operations were running at the time of the observed emission. On-site inspection may pinpoint poor operating procedure on a NSPS covered source. A finding of poor operation or maintenance is itself a violation of NSPS and may be supporting evidence that a new source has discharged visible emissions to the atmosphere in violation of NSPS emission standards. On-site inspection of control devices and records should indicate whether those devices were maintained and operated at their performance test conditions during a period of possible emission limit violation.

2.4 HAZARDOUS SOURCES

Under Section 112 of the Clean Air Act the Administrator of EPA has promulgated National Emission Standards for Hazardous Air Pollution Sources (NESHAPS). The first set of standards was applied to emissions of asbestos, mercury, and beryllium. On occasion the brass and bronze smelting and refining industry may use beryllium as an alloy so air pollution officials should inquire of the owner or operator about its use.

3.0 PROCESS DESCRIPTION, ATMOSPHERIC EMISSIONS, AND EMISSION CONTROL METHODS

There are approximately 60 producers of brass and bronze ingots in the United States. In addition, there are several thousand foundries and about a dozen primary smelters. The foundries basically just melt the copper alloys for subsequent molding into various consumer products and the air pollution potential is therefore quite small. The primary smelters, on the other hand, use mineral ores from the mines as their main source of copper; they may use some scrap. These primary copper smelters are located in Arizona and other western states. Their air pollution potential is very great both from particulates and from sulfur dioxide emissions.

The brass and bronze smelting and refining industry is concentrated in our Nation's population centers, primarily in the northeastern, midwestern and Pacific coast states. The reason for the location is that their basic raw material is not ore or virgin metal but copper-base alloy scrap which is collected by commercial scrap dealers. Thus the term secondary smelters refers to the source or origin of the copper and not to the quality of the ingots produced. The annual ingot production is about 300,000 tons, so with 60 producers, an average facility would pour somewhere around 5,000 tons per year. Brass and bronze are generally considered to be copper-base alloys with zinc and tin respectively as the largest secondary components. However, there are many more possible alloys as illustrated by the fact that the Brass and Bronze Ingot Institute produce 31 standard copper-base alloys (see Appendix E).

3.1 PROCESS DESCRIPTION

Raw materials consist of copper bearing scrap, i.e., faucets, telephone or electric cable, radiators, brass turnings, etc. The scrap is sorted into piles of like materials (similar alloys) and foreign matter and impurities are removed. Scrap cleaning may include several different unit operations. Burning oil or paint off the scrap surfaces is often required for oil covered turnings. Plastic coated copper wire may be burned, hand stripped or run through a hammer mill to separate the coating material from the copper. Large scrap items may be heated in a sweat furnace to remove specific metals such as lead by melting at predetermined temperatures. Iron materials

can be magnetically removed and light materials by gravity separation in a water medium. None of the above described processes are covered by EPA's NSPS.

One major scrap preparation process, which is covered by the NSPS, is the blast furnace (cupola). The blast furnace (cupola) used in processing secondary copper is similar to those in the ferrous industry, cylindrically shaped and vertically standing. This furnace is a continuous process that accepts slag skimmings and other metal oxides which are the byproducts of the ingot production furnaces. Coke, copper oxides and other materials are charged into the top of this furnace and combustion air, sometimes enriched with oxygen, is blown in through tuyeres at the bottom. The resulting metal (black copper) settles to the bottom and is drawn off for subsequent refining in the ingot production furnaces.

After the scrap is sorted and cleaned or reduced by the blast furnace, it is melted in a batch type furnace, impurities are burned out with help from fluxes, alloys are added to bring the batch up to specification, and the refined metal is poured into ingots and sold. Brass and bronze ingots are produced from three types of furnaces--reverberatory, rotary or crucible. In the industry, 95 percent of the brass and bronze ingots are produced by direct oil or gas-fired reverberatory furnaces. Probably the second most commonly used furnace is the direct-fired rotary furnace but, by EPA definition, it is classified as a reverberatory and must meet the same new source performance standard. Reverberatory furnaces operate by radiating heat from the gas or oil fired burners and the surrounding hot refractory lining onto the contents of the furnace. The flame and products of combustion come in direct contact with the charge material. The furnace is commonly rectangular in shape with a shallow hearth and constructed of fire brick and refractory materials.

The crucible furnace is very small, indirectly fired by gas, oil, or electricity, and used primarily for refining special alloys. Only the electric crucible furnaces are covered by EPA's NSPS; gas or oil-fired crucible furnaces are not.

In the furnace operation there are five fairly distinct steps to producing a batch of brass or bronze of the desired specification. First, the scrap materials are charged into the preheated furnace (charging). Second, oil or gas is fired directly into the charge to melt the materials (melting). Third, the charge is brought to the desired temperature and fluxes are added to remove impurities such as carbon, metal oxides, gases, etc. (refining or smelting). Fourth, after the impurities are removed, metal is added to bring the alloy to the proper metallic composition (alloying). Fifth, when

analysis indicates the correct grade has been achieved and the melt is at the proper temperature, the metal is poured into ingots (pouring).

A typical weekly schedule at one plant consisted of lighting the furnace Sunday afternoon, melting and smelting on a continuous basis from Sunday through Friday, with pouring normally completed during the morning hours. Furnaces were turned off on Saturday.

For a more complete description of the unit operations utilized by the secondary brass and bronze industry, refer to:

- Air Pollution Engineering Manual (8).
- Air Pollution Aspects of Brass and Bronze Smelting and Refining Industry (14).

3.2 ATMOSPHERIC EMISSIONS

3.2.1 General

Emissions from the brass and bronze industry are primarily particulates. Most of the furnaces are fired by natural gas or oil so sulfur dioxide, nitrogen dioxide, hydrocarbons, and carbon monoxide emissions are not too important. These gaseous emissions are not regulated by the new source performance standards although some state regulations on gaseous emissions might be applicable. For example, sulfur-in-fuel regulations could limit sulfur dioxide emissions. Nitrogen dioxide emission limitations might apply to the larger reverberatory furnaces. Carbon monoxide emission limitations might be applicable to the blast furnace where exhaust gases contain large quantities of CO. Hydrocarbon limitations might be applicable to the removal of cutting oils from chips, borings, or turnings with heat or combustion. The National Emission Standards For Hazardous Air Pollution Sources might be applicable in a few isolated cases if beryllium is used as an alloy.

Considering particulate emissions from the brass and bronze industry, the major sources are the furnaces which are regulated by the NSPS. However, to be complete all industry sources are considered, starting with the raw material handling and preparation.

Raw material handling generally does not produce fugitive dust since most of the scrap materials are large or contain some oil on their surface. Slag handling can produce some dust but it generally is in chunks like clinkers or gravel as opposed to fine powder. Furthermore, fuels are piped and the coke contains only minimum amounts of dust.

Raw material preparation can be done mechanically such as wire stripping with the only potential pollution problem being solid waste. It can be done with water and the potential is water pollution. If heat is used (pyrometallurgical processes) then a potential air pollution problem exists to some degree. Sweat furnaces are operated at medium to low temperature to melt materials such as solder from old car radiators. Principal emissions are particulates from antifreeze residue, soldering salts and hose connections; metal fumes are minimal. Of five sweat furnaces surveyed in 1968, four had no control equipment and one was served by an afterburner and baghouse (14).

Burning of insulation on copper wire produces large quantities of smoke and other particulates (up to 39 gr/scf) as well as large amounts of gases. If plastic coatings are being burned the effluent gases will contain high concentrations of chlorides or fluorides. One such facility in Maryland measured halogens of several ppm in the stack gases (5). From the BDII survey in 1968, only one wire burning furnace was listed and it was served by an afterburner (14).

Drying oil from copper chips, turnings or borings creates considerable amounts of smoke and hydrocarbons. The emissions generated obviously relate to the quantity of oil present on the scrap. Vaporized fumes must be burned in an afterburner to prevent excessive air pollution.

3.2.2 Blast Furnace

The blast furnace produces black copper from slag, skimmings, and other residues. Emissions include oxides of various metals, silicon, coke dust, smoke, and carbon monoxide. Discharge points include the stack, charging doors, and metal tapping spout. Without control equipment, emissions will create a plume of 60 to 100 percent opacity (8). The mass emission rate on one tested cupola was 0.68 gr/scf, 216 lb/hr, and 73.2 lb/ton (14). The slag tap is not a major emission point. The slag is rich in zinc oxide but it is in solution and does not volatilize to any extent and it is quickly quenched with water. Blast furnace (cupola) emissions are limited to 10 percent opacity by the NSPS. Emissions will be increased with an increase in slag fines charged to the blast furnace. Emissions will increase with the air blowing rate through the tuyeres. Emissions will increase with the amount of dirt or oil on the scrap charged

3.2.3 Reverberatory, Rotary and Crucible Furnaces

The ingot producing furnaces include the reverberatory, rotary, and crucible. The NSPS apply to the reverberatory and by definition includes the rotary. Crucibles heated by electricity also are regulated by the NSPS. As pointed out earlier the industry produces 95 percent of its ingots by reverberatory furnaces. Also the chemical makeup of emissions and the factors which influence emission rates are similar so these factors will be discussed as they apply to all ingot producing furnaces but with emphasis on the reverberatories.

Probably the most important factor affecting metal fume emission rates is the percentage of zinc in the alloy. The rate of discharge of zinc oxide will be proportional to the amount of zinc in the alloy. This is a factor because zinc has a relatively low boiling point compared to copper and other alloy materials. Lead oxide is probably the second most common fume especially in the high-lead alloys.

Type and condition of the scrap raw materials may affect emission rates. Oily and dirty scrap will create considerably more smoke and particulate emissions.

Location of the charging doors is important. Top loading doors allow excessive emissions when opened whereas end or side charging doors may be under negative pressure when opened and only small quantities of effluent will escape. Even with side or end charging, however, the firing rate should be reduced to prevent excessive discharges.

Air blowing rates will affect emission rates. Compressed air is blown into the molten bath of metal to selectively oxidize metals in accordance with their position in the electromotive series. Iron, manganese, silicon and aluminum are high in the series and are therefore oxidized. For a typical 50-ton reverberatory furnace, a 160 cfm of compressed air will volatilize and oxidize up to 750 pounds of zinc per hour in the metal bath. Based on the total volume of gases, of course, this could result in a ZnO concentration of 20 gr/cf at the furnace exit.

Flux covers, which are eventually skimmed off, prevent excessive volatilization losses. On the other hand, a thick layer is not desirable from the operator's viewpoint since it will reduce heat transfer to the melt. A slag cover of about 1/2 inch is desirable although thicknesses up to 12 inches are not uncommon.

The quantity of zinc or other volatile metal alloy that must be added to the melt at the end of the refining step will affect emission rates. Emissions are less if the initial charging period can include the right combination of alloy constituents. When zinc bars are added towards the end of the refining step, the flux cover is broken, the molten metal is very hot and zinc oxide emissions are greater. The oxidation of zinc is an exothermic reaction, thereby, generating large quantities of heat.

Pouring temperature also is important to the quantity of fumes generated. For a given percentage of zinc, an increase of 100°F increases the rate of loss of zinc about three times. The boiling, pouring, and melting points of metals and alloys are shown in the BBII publication. Highlights of the pouring temperatures are indicated below:

High nickel alloy	≈ 2400°F
High lead alloy	≈ 2300°F
High zinc alloy	≈ 2100°F
Magnesium alloy	≈ 1400°F
Aluminum alloy	≈ 1350°F

Notwithstanding all of the variables that can affect emission rates, test data on two reverberatory furnaces (100 ton and 60 ton) showed emissions on the order of 50 to 150 lb/ton. The test data are summarized (14). Apparently about three percent of the total material charged to the furnaces is eventually collected in the baghouses. Two rotary furnaces were tested (17.5 and 4 ton) and showed a similar emission range of about 30 to 150 lb/ton. Limited data indicate that concentrations of dust from brass furnaces may range from 0.03 to 4.1 grains per standard cubic foot (scf). Concentrations as large as 20 grains per cubic foot may be expected during the use of compressed air beneath the molten metal.

Electric furnaces discharge much smaller quantities of particulate fume. No tests were conducted by EPA prior to establishing the NSPS standard. Certain electric furnaces were felt to be able to easily meet the standards since an electric furnace in a brass and bronze foundry showed only 2.8 lb/ton of emission.

3.3 EMISSION CONTROL METHODS

The principal control device used to reduce particulate emissions from secondary brass and bronze furnaces is the fabric filter baghouse. In the case of controlling blast furnace emissions, the

baghouse is generally preceded by an afterburner which incinerates oily and sticky materials thus avoiding blinding the bag fabric. The high concentration of carbon monoxide released by the blast furnace is converted to carbon dioxide by the afterburner. The nature of the reverberatory furnaces allows for this operation to be performed within the furnace. Prior to entering the baghouse the hot furnace gases must be passed through some type of cooling facility so that the temperature is compatible with the bag fabric. Another method of controlling furnace emissions that has proven successful is the high energy venturi scrubber. Here prior cooling of the gas may be unnecessary.

Most commonly, a pull-through type, compartmentalised bag house is used because it allows for easier maintenance than a single chamber house. Generally, the tubular bags used are constructed of dacron which has been found to be a good cost/life compromise although in some cases fiberglass material is used. The gas temperature must be reduced to about 300°F for dacron or about 500°F for fiberglass so that the bag fabric will not be destroyed. Some type of cooling duct system, commonly preceded by a water spray, is employed to obtain the necessary temperature reduction. Also, it is fairly common to have a thermally controlled damper which allows dilution air into the gas stream prior to entry into the baghouse for additional cooling. The operator must also be careful to keep the temperature of the gas entering the baghouse at least 50°F above the dew point of the gas to prevent condensation within the unit. This would cause caking on the bags and the resulting pressure build-up would ultimately rupture the bag fabric. In addition to the water, acids will also be formed from the sulfur oxides, etc., in the gas, causing damage to the bag fabric and corrosion to the house structure. A gas volume to cloth area ratio of up to 2 acfm/1 sf is commonly employed for efficient operation of the collection system. Most likely, the only monitoring instrument used with a baghouse will be a manometer which measures the pressure drop across the entire system. This will commonly range up to 6 in H_2O gage. It is economically unwise for a plant to allow excessive amounts of dilution air into the system or to maintain a very high pressure drop across the bags. The manometer will indicate a bag rupture by the resulting drop in pressure but the obvious increase in visible emissions emitted by the baghouse is the more common method of establishing a malfunction in the baghouse.

Venturi scrubbers are not utilised as commonly as baghouses in the secondary brass-bronze industry. Depending on the application they can vary between 30 and 100 in H_2O pressure drop.

In some cases, the furnace gas temperature has to be reduced by water sprays to prevent adverse operation of the scrubber. A 60 in. H_2O pressure drop corresponds to a throat velocity of about 200 ft/sec and water requirements of about 3 gallons per minute per 1,000 acfm of gas. Almost all scrubbers still have a manometer or other gauges to indicate the pressure drop across the unit. To a lesser degree, the water flow rate within the scrubber is important. Some modern plants still have monitoring systems that record the pressure drop, water flow rate, and the gas flow rate to the scrubber. However, wet scrubbers and electrostatic precipitators have not been particularly successful in the collection of zinc oxide fumes. Three scrubbers serving brass-melting furnaces reported efficiencies between 93 and 65 percent. Pressure drop was not indicated but was probably not too high. To achieve the control efficiencies required to meet the NSPS, pressure drops would have to be on the order of 50 to 60 inches of water. Apparently an electrostatic precipitator has recently been adopted as a control device but no details are available on its application or performance. Their potential application to the brass and bronze industry is small however since industrial precipitators are not common on gas flows below about 20,000 acfm. Future use of electrostatic precipitators may be facilitated as more experience and information are gained.

The BBII members account for 40 percent of the industry's total ingot production. The members completed questionnaires on the air pollution control equipment in use in the industry. Results are shown in Table 3.1.

The Environmental Protection Agency selected four plants for source testing and three were successfully tested. The fourth test was aborted because plant malfunctions during testing rendered the test results invalid. All furnaces were controlled with fabric filters and all showed average emission rates below the standard of 0.022 gr/dscf. The three emission rates were 0.001, 0.006, and 0.008 gr/dscf. Results of other tests conducted by Federal, state, and local agencies showed emission rates to range from 0.002 to 0.017 gr/dscf from reverberatory furnaces with a size range from 7.5 to 100 tons and all controlled by fabric filters.

Results of one blast furnace test revealed emissions of 0.013 gr/dscf and there were no visible emissions. No electric furnaces were source tested.

It is common practice in the industry to manifold the exhaust from several furnaces into a common control system thus achieving some economy of scale. Also it is common and necessary to cool the

Table 3.1 AIR POLLUTION CONTROL EQUIPMENT IN USE IN THE INDUSTRY

Furnace type	Number	Approximate capacity, tons	Control Equipment
Reverberatory	[illegible]	[illegible]	Baghouse
			Baghouse
			None
			Baghouse
			None
			Baghouse
			None
			Baghouse
			None
Rotary			Baghouse
			None
			Baghouse
			None
			Baghouse
			None
			Baghouse
			None
			Baghouse
			None
Electric		(?)	Baghouse
			Baghouse
			Baghouse
			Scrubber
Crucible-			None
			None
			None
			None
			None
			None
			None
Kettle			None
			None
Cupola			Afterburner & baghouse
			Baghouse
			None
Wire burning			Wet collector
			Afterburner chamber
Rotary dryer			None
Incinerator			Afterburner
Raw material concentrator			Cyclone
			None
Slag furnace			Baghouse

exhaust gases from the furnaces prior to entering the fabric filter. This is accomplished by use of radiation cooling, water sprays, and/or air dilution. Since the fan on the end of the system pulls a fairly constant gas volume the success of the system depends on the radiation and water spray cooling to eliminate the need for air dilution cooling directly ahead of the fabric filter. If this air dilution damper opens, the bags are protected but the collection efficiency of the hoods over the furnace will be diminished. Obviously the grain loading going out of the bags will be low but more of the metal fume will be escaping the hoods and discharging to the atmosphere through the plant's roof monitors.

In the BBII industry survey three of the eight furnaces tested were reported to be capturing only 80-85, 80-85, and 90-95 percent of the generated emissions. In the EPA new source performance standard testing, it is noteworthy that the pouring phases of the heats were not tested because none of the facilities adequately collected emissions during this phase of the heat.

One other experience of the BBII testing may be important from the standpoint of NSPS compliance. Tests on a cupola effluent were taken prior to and after a baghouse. Results showed that stack gas volume at the baghouse outlet was two to three times the baghouse inlet gas volume. The discrepancies were attributed to leaks in the baghouse structure. The stack gases would have come close to meeting the NSPS of 0.022 gr/dscf while the efficiency of the baghouse was between 74 and 85 percent.

In addition to BBII experience, visits to brass and bronze plants were conducted by the authors. At one plant with three rotary furnaces (capacities of 100,000, 30,000, and 6,000 pounds) and two reverberatory furnaces (capacities of 3,000 pounds), the 30,000 and 6,000 pound rotary and both reverberatory furnaces were operating. Blowing air was introduced for 5-10 minutes on the rotary furnaces to remove concentrations of zinc oxide. Emission controls on the five furnaces consisted of 25,000 scfm fans in the ductwork from the hoods, connected to a water spray cooling and settling chamber and two baghouses. Hoods were located over the charging doors and pouring areas with air being moved by a 25,000 scfm fan and ducted to the settling chamber. Oxide escaping to the roof was collected through four dust collectors of 15,000 scfm each serving the roof monitors.

Baghouses were one six-compartment Wheelabrator of 23,000 scfm and one six-compartment Taylor of 75,000 scfm. Cleaning of baghouses was accomplished by compartment. A normal cleaning cycle was to shake compartment bags for 90 seconds, allow 15 seconds for particulate to settle with a time delay of 30 seconds before moving to the

next compartment of the baghouse. Thus, two minutes and 15 seconds were required for cleaning one compartment of the baghouse. To clean one baghouse, 13 minutes and 30 seconds were required (2 min. 15 sec. x 6 compartments = 13 minutes 30 seconds). At the time of the visit, one baghouse was off the line for repairs and one of four 15,000 acfm dust collectors was being used for roof monitor gas cleaning.

Air blowing of the molten metal at one plant was done at 60 psi while at another plant 30 psi for blowing air was found. Normally 4,000 fpm (approximately 67 fps) was the minimum velocity utilized to eliminate settling of dust in the ductwork. Fan speeds were not checked by the plant operators at the facilities visited; however, determination of rpm would pose no problem. A more difficult problem would be that of checking full-load amperage on electrical motors. At one plant with a 75,000 acfm baghouse, static pressure was -16" H_2O by the fan, -1" H_2O in the duct ahead of the baghouse, with only 10" ΔP on the compartments. In this inspection, a door was found open on one of the compartments.

Further detail on air pollution control equipment applications on secondary brass and bronze smelters can be obtained from:

(1) Air Pollution Engineering Manual (8)

(2) Background Information for Proposed New Source Performance Standards (4)

(3) Proceedings: The User and Fabric Filtration Equipment Specialty Conference (13)

(4) Sources of Air Pollution and Their Control (19)

(5) Study of Technical and Cost Information for Gas Cleaning Equipment in the Lime and Secondary Non-Ferrous Metallurgical Industries (13)

(6) Control of Metallurgical and Mineral Dusts and Fumes in Los Angeles County (1)

(7) Control Techniques for Particulate Air Pollutants (7)

A schematic of the air pollution control system commonly found in the brass and bronze industry is shown in Figure 3.1.

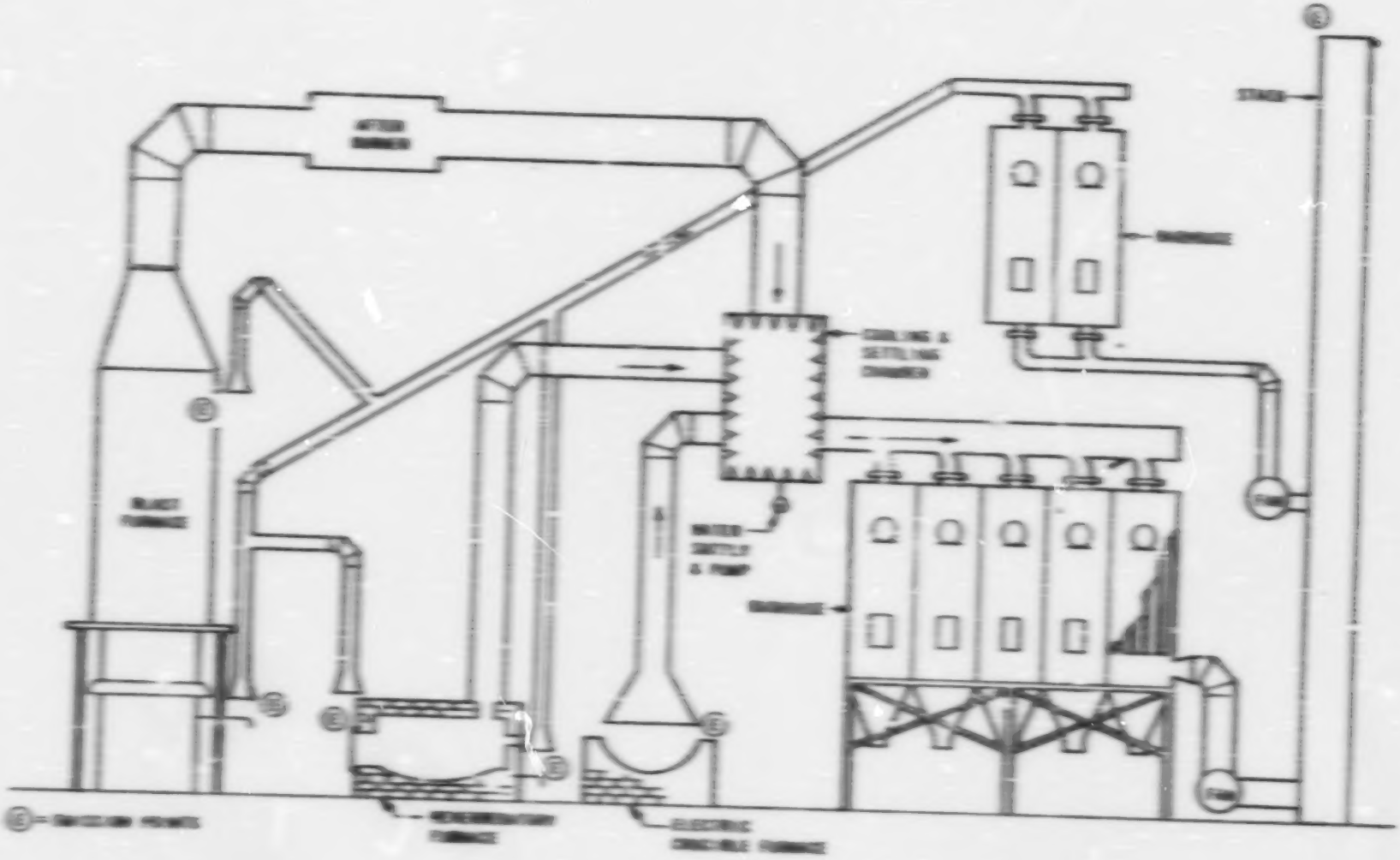

Figure 3.1 Air pollution control system in the brass and bronze industry

4.0 MONITORING, RECORDKEEPING, AND REPORTING REQUIREMENTS

4.1 MONITORING THE PROCESS, CONTROL DEVICE, AND EMISSIONS

One purpose of monitoring the operations and maintenance of the furnaces at secondary smelters is to ensure that the compliance determined by performance tests is maintained on a continuing basis by proper operation and maintenance of all equipment.

From an air pollution control viewpoint, the major problems associated with secondary brass and bronze smelting are efficient capture of particulate matter generated by the furnaces and subsequent removal of the particulate by abatement equipment. It has been positively shown that with current air pollution control technology, particulate emissions from the plants can be reduced to meet all applicable Federal and state emission standards. Thus assuming proper design of the abatement system, the problem becomes one of proper maintenance and use of the equipment.

At the present time, the new source performance standards for new or modified secondary brass and bronze ingot production plants do not require any monitoring equipment on the process, control equipment, or emissions. However, either specific or general monitoring requirements may be in effect under certain State Implementation Plans, although again, EPA has not promulgated any minimum requirements for secondary brass and bronze ingot production plants.

4.2 RECORDKEEPING

Since automatic monitoring is not presently required for brass and bronze plants, recordkeeping on a routine basis becomes extremely important to provide a method for the air pollution control officer to determine that operating and maintenance practices are consistent with reasonable air pollution control needs. Records should be kept on production processes, on control equipment and on emissions. Each of these parameters are described separately although obviously there are interrelationships.

Also it should be clear that the suggested recordkeeping is not now required by the NSPS and probably not by any of the state agencies. Section 114(a)(ii) of the Clean Air Act, as amended, provides that the Administrator may require the owner or operator of

any source to provide information for the purpose of determining whether any person is in violation of any such standard or any requirement of such a plan." This is one of the most important enforcement tools under the Clean Air Act, in that the source can be required to provide the information which may be the basis for later enforcement by EPA.

The facility operator should maintain a description (tabulations and schematic diagrams) of the plant identifying major equipment items, types of furnaces and controls used for smelting operations. Within the brass and bronze smelter there are several different types of furnaces. However, the types of records that should be maintained are similar. On each furnace, the following information should be recorded for each heat or batch:

- Process or charge weight rate and quantity of ingots produced, to nearest ton;
- Specification of the ingots, using BBII standards;
- Date and time heat began and ended, to nearest hour;
- Fuel consumption, to nearest 100 cubic feet or 10 gallons;
- Oxygen consumption, to nearest 100 cubic feet;
- Slag handling process and H_2S emission control;
- Compressed air consumption, to nearest 100 cubic feet;
- Flux identification by constituents and consumption, to nearest 100 pounds;
- Gas flow system data, power requirements, exhaust flow rate;
- Malfunctions; and
- Operating deviations for above items.

The purpose of recording the above process data is to be able to compare the batch or heat production cycle with the production at the time of the performance test. The emission rate for a given ingot specification will increase if the heat is produced quicker by using more fuel, more oxygen, more compressed air, etc. Also, the capture efficiency of the hoods would probably decrease as production rates increased above the performance tested production rate.

Since the blast furnace (cupola) operation is continuous the above information should be recorded at the end of each shift or three times daily.

The exhaust gas collection, venting and emission control system should be described (diagrammed) in detail. The sequence of controls, types of controls (afterburners, cooling system, particulate material collectors, baghouses, filter types) should be outlined and described using quantitative parameters.

For each control component or system checkpoint, information recorded, at the intervals indicated, should include:

- Quantity of collected dust and fume, by month to nearest ton;
- Volumetric flow on inlet to collector, on first of each month;
- Volumetric flow on outlet from collector, on first of each month;
- Pressure drop across each section of the collector after cleaning, on first of each month;
- Static pressure from fan through collector, gas cooling system and ductwork to collecting hood, on first of each month;
- Fan speed, on first of each month;
- Capture velocity at hood faces, on first of each month;
- Excess air data for gas exhaust system and results of any Monoxor (CO detector) and Pyrite (O_2 detector) analyser surveys;
- Inspections, maintenance and repairs, by month; and
- Malfunctions.

The purpose of having the above information kept on the air pollution control system is to ensure that air contaminents generated by the furnaces will be collected by the baghouse or other collection system the same as when the performance tests were conducted. The quantity of dust collected should remain proportional to the production of furnaces hooked to the system. The volumetric flow measurement on the inlet and outlet will indicate leaks in the baghouse. Pressure drop after cleaning will indicate if the bags are becoming badly worn or blinded by dust. Static pressure measurements will indicate leaks in ductwork or ductwork filled with dust. Capture velocity at the hoods will indicate if the capture efficiency is changing.

For the emissions, the owner or operator should not record visual opacity unless the observer has been certified by EPA or a State Agency to make such opacity observations. The plant operators should record and report complaints and should indicate the probable cause of the problem.

4.3 REPORTING REQUIREMENTS

The proposed EPA reporting requirements suggest that the owner or operator of a source subject to continuous monitoring and recording requirements should summarize such measurements monthly and should submit such summaries to the state on a quarterly or more frequent basis. As will be described later, the Federal requirement for new facilities to report startup, malfunction or shutdown is on a quarterly basis. Therefore, it seems logical and consistent to suggest the above records also be summarized on a monthly basis and submitted to the state quarterly.

Also the NSPS regulation requires owners and operators to maintain a file of all recorded information required by the regulations for at least two years after the dates of such information.

Suggestions for formats and contents of inspectors worksheets are indicated in Tables 6.1, 6.2, 6.3 and 6.4 at the end of Section 6.0.

For further detail on monitoring, recordkeeping, and reporting requirements, please refer to:

- Federal Register, October 6, 1975, page 46240 (10);
- Federal Register, October 6, 1975, page 46250 (10);
- Guideline for the Selection and Operation of a Continuous Monitoring System for Continuous Emissions (12).

5.0 STARTUP, SHUTDOWN, AND MALFUNCTIONS

The Code of Federal Regulations, Title 40, Part 60, addresses the problem of startup, shutdown, and malfunctions. Section 60.11 (d) states, in part, "at all times, including periods of startup, shutdown, and malfunction, owners and operators shall, to the extent practicable, maintain and operate any affected facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions." At another part, Section 60.7 states, "A written report of excess emissions as defined in applicable subparts shall be submitted by each owner or operator for each calendar quarter. The report shall include the magnitude of excess emissions as measured by the required monitoring equipment reduced to the units of the applicable standard, the date, and time of commencement and completion of each period of excess emissions. Periods of excess emissions due to startup, shutdown, and malfunction shall be specifically identified. The nature and cause of any malfunction (if known), the corrective action taken, or preventive measures adopted shall be reported. Each quarterly report is due by the 30th day following the end of the calendar quarter. Reports are not required for any quarter unless there have been periods of excessive emissions."

The above provisions presently apply only to three furnace types at new brass and bronze ingot production plants. However, the state agencies may well adopt similar requirements and in fact some states already require existing plant upset conditions to be reported. The principal difference, however, may be in EPA's definition of malfunction which excluded several common causes of excessive emissions. The wording is as follows: "Malfunction means any sudden and unavoidable failure of air pollution control equipment or process equipment or of a process to operate in a normal or usual manner. Failures that are caused entirely or in part by poor maintenance, careless operation, or any other preventable upset condition or preventable equipment breakdown shall not be considered malfunctions."

Suggestions for format and content of recordkeeping on start-up and shutdown operations and malfunctions, are indicated in Table 6.3 at the end of Section 6.0.

5.1 STARTUP

Startup operations are common practice, occurring daily, in the brass and bronze industry. Since almost all of the furnaces are batch operations, startup of the furnaces poses no particular problem from the emission point of view. When a furnace is being heated up, only fuel is being burned. Even a blast furnace which is a continuous operation starts by heating up the furnace and it typically takes about four hours to reach normal operating conditions. The reverberatory furnace is a continuous operation also but it may be somewhat cyclic depending on the rate of scrap addition and the rate of copper draw-off.

5.2 SHUTDOWN

Shutdown of the furnaces can be more of a problem than startup, however, since several tons of molten metal cannot be allowed to solidify in any of the furnaces. In the event of a malfunction or failure in the control equipment (baghouse or scrubber), the furnace must be vented to the atmosphere for the remainder of the heat cycle or until the furnace can be prepared or stoked for holding. It is not desirable to allow the firebrick to become completely cold since damage to the firebrick may occur with frequent or extreme temperature changes. Thus, for a furnace with a 24-hour cycle time, it is conceivable that several hours could pass with excessive emissions before correction.

5.3 MALFUNCTIONS

Concentrating then on malfunctions that could cause excessive emissions, two types of malfunctions may be considered. The first category is made up of those conditions which would create excessive emissions into the workspace with subsequent discharge through the roof monitors to the atmosphere. Such a condition would conceivably be manifested by pouring ingots at higher temperature than necessary but would generally be due to insufficient draft on the collection hoods which could be due to:

- slippage on fan belts
- high pressure drop in the baghouse which in turn may be due to:
  - improper compressed air supply
  - improper timer operation
  - improper solenoid valve operation
  - leaky airlock or dust discharge valve
  - moisture blinded bags
  - dust in clean air plenum
  - static electricity

- incorrectly installed blow tubes
- collector overloaded from too much air

- fan rotating in the wrong direction;

- leaking ductwork, access doors, explosion doors or discharge valve on air lock;

- clogged ductwork or faulty damper;

- duct size improper; and

- higher temperatures and increased gas volumes of the exhaust gases which would cause the atmospheric damper to be opened excessively. This condition in turn could be caused by:

  - addition to the furnace charge of scrap with high amounts of aluminum, magnesium or other low boiling point alloys;
  - addition to the blast or reverberatory furnace charge of scrap with large amounts of oil or other combustibles;
  - blowing the molten bath at too high a rate with compressed air;
  - firing at excessive rates especially with use of oxygen;
  - adding large quantities of zinc late in the refining process;
  - hardened or insufficient slag cover in the reverberatory furnace; and
  - slips in the blast furnace following bridging.

The second category of malfunctions would result from control equipment failures. The more important examples would include:

- short bag life with frequent failures (ruptures) which in turn could be due to:

  - high operating temperatures
  - low dew point gas conditions with condensation of SO_2 and SO_3
  - acidic or basic dust that attacks fabric
  - a high filtering velocity, air to cloth ratio; or high ΔP
  - excessive bag cleaning or shaking
  - dust in clean air plenum from previous bag failures or from bridging of dust in the hopper cleanout

- poor water distribution due to buildup of mud;

- pump failure;

- motor failure;

- fan unbalanced due to particulate buildup; and
- clogged or worn nozzles

For further information on baghouse design, operation, and maintenance please refer to the following reference materials:

- Appendices to Handbook of Fabric Filter Technology (3)
- Proceedings: The User and Fabric Filtration Equipment Specialty Conference (15)
- Air Pollution Engineering Manual (8)
- Air Pollution Aspects of Brass and Bronze Smelting and Refining Industry (14)
- Systems Study of Scrubbers (20)

6.0 INSPECTION PROCEDURES

6.1 CONDUCT OF INSPECTION

Before an air pollution control official inspects a facility, it is necessary to establish the objectives of the inspection. In this regard, he may wish to check with his administrative, legal, or engineering advisors prior to the inspection since some or all of the following objectives may be important for a given plant inspection:

- Determine the scope of the facility's operation.
- Determine the applicability of standards.
- Inspect records and/or monitoring equipment.
- Evaluate visible emissions (Appendix B).
- Determine if a stack test is required.
- Conduct or observe stack tests or other field tests.
- Evaluate maintenance and operation of equipment.
- Establish compliance or non-compliance with compliance schedules.
- Investigate feasibility of various control methods.
- Investigate compliance with emergency episode plans.

Section 114(a)(2) of the Clean Air Act enables the Administrator or his authorized representative to enter a source so that EPA can do its own monitoring, sampling, inspecting, or copying of records. Such authority may be delegated to a state and be exercised by a state official.

In preparing for the inspection, the control official should:

- Review the literature on the subject industry's process descriptions, inspection points, and control equipment.

- Review the NEDS file or other plant file for details of processes and control equipment in use (including plot plan.

- Review applicable standards (Federal, state and local).

- Review enforcement history on the plant.

  - administrative and court actions
  - compliance schedules
  - monitoring and recordkeeping requirements
  - previous inspections
  - section 113 abatement actions
  - waiver, notifications, quarterly reports, registration (NESHAPS and NESHAPS)

- Finalize objectives.

- (If appropriate) provide advance notice.

- Obtain credentials and business cards (EPA has a procedure for generating the issuance and control of credentials).

- (If desired) obtain for handout a supply of applicable statutes and regulatory authority as well as EPA or state literature explaining the enforcement program.

- Obtain or develop a supply of inspection checklists.

- Obtain personal safety equipment. (A source owner or operator has no responsibility to supply EPA inspectors with safety equipment.)

  - hard hat
  - safety glasses or goggles
  - steel-toed shoes
  - respirator
  - gloves
  - coveralls

- Obtain necessary inspection equipment.

  - tape measure
  - flashlight
  - thermometer and gauge
  - manometer (flex-tube)
  - inclined manometer
  - RPM indicator

- velometer
- camera
- Fyrite combustion analyser - O_2, CO, CO_2
- smoke spot analyser

6.2 INSPECTION CHECKLIST

After preparing for the inspection by reading appropriate information and obtaining necessary equipment, the control official is ready for the actual site visit. Before entering the plant property it is desirable to observe the stacks and roof monitors for evidence of visible emissions. If a plume is consistently visible, opacity observations should be recorded for possible violation. Time should be allowed for such observation prior to the appointment.

At the plant entrance, present credentials and request to see the most senior or responsible official of the company. Generally this person will be the plant manager. The inspector should not sign the waiver forms or "visitor releases" prior to entry. The inspector has specific legal authority (Federal or state) for right of entry and signing such forms may adversely affect his Federal or state insurance or survivor benefits. If a source persists in its refusal, the matter should be carried to court. If a source simply refuses right of entry, a request must be made through a U.S. Attorney for a search warrant.

Upon meeting the plant manager, the inspector may be questioned on the following items and should be prepared to discuss:

- The purpose of the inspection (NSPS, SIP, NESHAPS).
- The authority for the inspection (114, 114, State law, etc.).
- The agency's organization and responsibilities.
- Recent history of legislative and enforcement activity affecting the subject industry and specific plant.
- The scope, timing, and organization of the inspection.
- Information and records to be examined (self incrimination - see Appendix).
- The treatment of confidential data (trade secrets - see Appendix).
- Possible measurements to be made.

Possible followup activity including:

- future inspections
- section 114 letter
- stack tests
- notice of violation

After the preliminaries are completed, the control official should request the name, title and address of the appropriate company officer for official contact on future inspections and correspondence.

Next, he should request a brief summary of the plant's production facilities and air pollution control equipment. This information will substantiate the NEDS or other emission source data that the agency has on file or will provide the basis for updating or correcting such files.

The company official should be asked to indicate which processes, unit operations, furnaces, and control equipment are (at the time of the discussion) operating at or near normal operating conditions. Likewise, the company official should be asked to indicate which facilities are not operating at or near normal operating conditions and to indicate the reasons and the timing (date and hour) for shutdown or malfunctioning equipment. The schedule for returning shutdown equipment to operation should be indicated. The malfunctioning equipment should be shutdown if such malfunctioning adversely affects emission rates to the atmosphere and the schedule for shutdown and correction should be indicated.

Next the inspector should request a quick rather cursory tour of the plant facilities and the company official should point out all of the sources and control equipment indicated earlier. Access to the roof and to the stacks should be requested and visual observations should be made of hood capture efficiencies, stack effluents, sampling ports and platforms, ductwork conditions, and general housekeeping in and around the plant. Evidence of dust or fume accumulation on the plant roof or at the stack exit should be noted. During this tour the control official should note whether the process, furnace, etc. is running and whether its operation warrants more detailed analysis.

After getting acquainted with the plant and its facilities, the inspector should request that the company official provide information from his records that will allow the inspector to complete the process, control equipment and malfunction worksheets which are appended. Records for several heats on each furnace prior to the visit will generally suffice to give a baseline of the plant's

operations. With such information, comparisons can be made with future operations, with past performance test and design operating conditions, and with operations at the time of the current inspection. In the event the company identified certain data confidential, a company official must make a request for such confidentiality in writing to EPA.

Next, the inspector should request the company official's assistance in verifying the real time operating conditions and actual production rate of each process, furnace, etc. in the plant. This plant inspection may take several hours and the records or data which the official cites--weights, fuel flow measurements, temperatures, etc.--should be seen and verified by the air pollution inspector. After verifying that certain equipment is operating, the inspector should be prepared to take his own data on fan speeds, gas velocity and duct flow rates, static pressure, and pressure drops, hood capture velocities, temperatures (both dry bulb and wet bulb). On equipment that is not operating, especially baghouses or other control equipment, the opportunity should be taken to open access doors to check ductwork, fabric bags, clean air plenum, valves and dampers, fan and drive belts, collection hoppers, etc. The inspector should take note of those conditions cited in Section 5.0 which can lead to malfunctions and check the equipment accordingly.

6.3 INSPECTION FOLLOWUP PROCEDURES.

Upon completion of the inspection, the inspector should sign and date all notes and inspection forms making certain that all blanks are completed. He should advise the company official that he will review his findings with his legal and technical advisors prior to making recommendations for any necessary action. The inspector should not advise the company official of specific violations. The conclusion of all inspections will be: (1) affected facilities are in violation of standards; (2) affected facilities are in compliance with standards; or (3) affected facilities are not being operated or maintained precisely in accordance with the permance tests but violations are not clearly evident. Where operating conditions have a high probability of producing greater emissions than those recorded during the performance tests, a new performance test may be required of the source by the Administrator. Also, poor maintenance and housekeeping is a violation of NSPS regulation 60.11d.

In the first case of new brass and bronze ingot production facilities subject to the NSPS, the only possible violations which could be cited are opacity violations or failure to record or report malfunctions. The mass loading limitation on reverberatory furnaces could not be determined without isokinetic particulate tests. On existing facilities state opacity limitations or reporting requirements for upset conditions would seem to be the only possible

violations. Obviously the agency whose regulation is being violated should be advised.

In the second case, the plant will be found to be operating and maintaining its facilities in a manner consistent with good air pollution control practice for minimizing emissions. Also the affected facilities will be found to be operating essentially at the production rates and under the conditions recorded at the time of the performance tests.

In the third case, which will be the most common and the most difficult, inspections will be concluded with a need for recommendations to improve specific operating or maintenance procedures so as to be consistent with the performance test conditions and with good air pollution control practice for minimizing emissions. If such recommendations are not followed and the inspector feels that emissions may be excessive, a performance test would be required to substantiate or refute compliance with the regulations. On the matter of what conditions constitute a significant deviation so as to require a new performance test, the inspector should not make a decision in the field. Instead he should record field data from which technical and legal advisors can draw such a conclusion.

Regardless of the findings, the designated company officer should be notified in writing of the inspection results and any required action on the company's part should be spelled out in detail with a time schedule to bring the facilities back into compliance. Section 113 of the Act should be cited. At the conclusion of the designated time period for compliance, a followup inspection should be made to verify conformance with the recommendations and applicable standards.

For further information on inspection procedures refer to:

- Field Surveillance and Enforcement Guide for Primary Metallurgical Industries (11)
- Workshop on Stationary Source Inspections (31)
- Air Pollution Control Field Operations Manual (17)
- S 12. - General Policy on the Use of Section 114 Authority for Enforcement Purposes (Appendix C).

Table A.1

[illegible]

Part I – [illegible]

Company

Street Address

City State

Official Completing Form

Title of Official

Date Tel

Date received

Pumper/Company Designation

Pumper Identification No. or Well No.

Pumper Type

Pumper Rated Capacity (Energy Input)

Start TIMES						Fuel				Time	[illegible]
Start Number	Energy Input,	Active Input,	Start Input,	Total Input,	Engine Controlling Material/Index	Elec Consum. at Charge	Fuel 10^6 btu	Engine ft^3	Air ft^3		Specifications [illegible]

Date Inspector

[illegible]

[redacted]

[redacted]

7.0 PERFORMANCE TEST

The Code of Federal Regulations, Title 40, Part 60 provide in Section 60.8 for performance tests of new brass and bronze facilities. The test calls for three separate runs using standard EPA test methods and procedures. The Administrator however can modify the testing requirement; he can even waive it. If tests are to be conducted, the owner or operator must give EPA 30 days notice. EPA must then specify the operating conditions of the tested furnace. At present, only new reverberatory furnaces have a mass emission rate which requires performance testing; electric and blast furnaces have only an opacity standard. At the time of the test, the inspector should be present to observe process and control device operation so that subsequent inspections can be correlated with the performance test "baseline" operating conditions. Also at the time of the tests, the inspector should check certain of the source testing procedures to ensure that the tests are conducted properly. Each of these three requirements is considered separately in the ensuing discussion.

7.1 PROCESS OPERATING CONDITIONS

The purpose of the performance test is to determine whether the emission standards will be met when the furnace is operating at normally encountered conditions that create the maximum emission rate. The operating conditions that should be specified for the tests are as follows:

- The production rate should be the maximum rated capacity of the furnace;
- The period of the heat should be the minimum possible to achieve the specification of the melt;
- The specification of the ingots to be produced should contain either a very high or very low percentage of zinc;
- If oxygen is used at all, the consumption rate should be the maximum rate anticipated;
- If compressed air is used at all, the consumption rate should be the maximum rate anticipated;

- The fuel consumption rate should be the maximum rate anticipated;
- The flux addition rate should provide a slag and flux cover depth typical of the operation to be tested; and
- The pouring temperature should be the maximum anticipated for the metal alloy being produced.

7.3 PROCESS OBSERVATIONS

Since a large reverberatory furnace will require several hours (on the order of 12-48) to produce one heat of brass or bronze, care needs to be exercised to source test during periods which produce maximum emission rates. Also different phases of the heat should be covered by the testing to ensure compliance over the entire heat. Some of the observations that should be noted during the testing and in between the tests are described below since the method of operating can affect emission rates.

The method of charging is important. If essentially all of the charge is added at the beginning of the heat, emissions will be lower than if material is subsequently charged to a hot operating furnace. If subsequent charging is practiced, emissions will be reduced if the fuel rate is decreased or stopped while charging.

The total charge, and thus the total production rate will affect emissions. Since most of the emissions are due to zinc oxidation, a furnace half full will have only one-half the mass rate of emission of zinc oxide. Yet the fuel consumption rate and certainly the air delivered to the baghouse will be nearly the same in both cases; thus, the grain loading will be reduced if the production is reduced. Overall, however, the total mass of charge is probably less a determinate of emissions than percent volatiles in charge, temperature, and production rate.

The duration of the heat is important in that the quantity of impurities to be removed remains constant regardless of the duration of the heat. There is effective dilution and lowering of the grain loading with longer than normal refining times. In the case of high zinc charges, a longer heat allows more zinc to boil off. Thus, there is a trade off involved in the total effect of longer duration heats.

The approximate zinc content of the scrap which is charged should be noted and the zinc content of the ingots should be noted. If the charge is high in zinc and the final product is low in zinc, then more blowing with compressed air will be necessary to remove

the zinc and most of this material will go to the baghouse. In the case where zinc is high in the finished ingots, emissions will be much greater during pouring of the ingots.

The oxygen, compressed air, and fuel consumption rates all relate to the speed with which the impurities in the molten metal are removed. If the rates are low and the time longer, emission rates will be less than if the rates are high and the time shorter. If the source test is conducted for only one hour or so, care should be exercised to include representative smelting conditions.

The thickness of the slag cover is important since the slag cover hinders the loss of low boiling point metals and impurities to the atmosphere. Slag covers are usually at least 1/4" to 1/2" thick. A thicker layer will reduce emissions but will tend to insulate the charge from the burners. Thus, a thicker layer than normal during a performance test will reduce mass emissions and increase the quantity of heat needed, thus giving a lower grain loading during the performance test.

If the pouring temperature is higher than necessary, the fume emission will be increased.

If a baghouse is the selected control equipment operation, it may be designed to meet the standard with one section off line for cleaning. If this is the case, the testing may be desirable with one section dampened off.

Also, since it is common practice to vent two or more furnaces to the same baghouse, it may be necessary to operate other equipment simultaneously or to bypass a portion of the baghouse and a portion of the production equipment to try to get air to cloth ratio and inlet grain loading that will be experienced under normal operating conditions of the reverberatory furnace. Whatever final procedure is determined for operating the control equipment, the inspector should note all conditions and should complete the Inspection Checklist Forms relating to the control equipment.

7.3 EMISSION TEST OBSERVATIONS

Emission tests and opacity determinations should be conducted by qualified emission testing personnel. The inspector is responsible for ensuring that all pertinent data are collected, that the field procedures and equipment meet CFR, and that the smelter is run at representative performance during all sampling runs. A

qualified technician or engineer reads visible emissions during the three particulate runs. The approved visible emission data form appears in Appendix B.

The inspector's degree of surveillance of the stack sampling team depends on the confidence of the inspector and qualifications of the test personnel. Even if the inspector has complete trust in the sampling crew, the following tasks should always be performed:

(1) Record duct dimensions (both inside and outside) and locations of sample ports.
(2) Check the number of ports at the sampling site and examine the ducting for the nearest upstream and downstream obstructions. Ask the crew leader how many total points will be traversed and check with Figure 1.1 in 40 CFR 60 to determine whether the stream will be properly sampled.
(3) Note whether the crew runs a preliminary traverse, and if so, inquire what nozzle diameter is selected. (Isokinetic sampling is a function of nozzle size.)
(4) Check to ensure that the moisture content of the gas stream is determined by Method 4 or an equivalent method such as drying tubes or volumetric condensers; assumption of the moisture content is not allowed. Note, however, that EPA has proposed a method for the estimation of the moisture content for the purpose of determining isokinetic sampling rate settings. The proposed method appears at 41 FR 23060 (June 8, 1976).
(5) Observe the leak test of the sampling train. The allowable leak rate is given in Method 5. Leakage results in lower concentrations than are actually present. Be next to the dry gas meter during the leak check to note whether the meter hand is moving. (The more the hand is moving, the greater the leakage.) Leak checks must be made if the train is disassembled during the run to change a filter or to replace any component.
(6) Record dry gas meter reading before and after test.
(7) Record average velocity head and temperatures in duct during test.
(8) If impingers are used during test, observe whether they are bubbling. If they are not, the sampling train is either plugged or disconnected from the pump.
(9) Check the cleaning procedure for the front half of the train. Careless removal of filters or cleaning of probes will result in lower calculated emissions. Look for broken glass from probes or connectors. The test is void if glass probe is broken during test. If glass connectors are broken in transport from sampling site to clean-up area, test is still valid. Be sure identification labels

are properly attached to collection containers. The probe should be brushed and rinsed with acetone thoroughly to remove all particulates. The probe should be visually inspected after cleaning to ascertain that all particulates have been removed.

(10) Observe gas analysis procedure for determining CO_2. Technicians should take at least three samples before averaging readings. Variations greater than 0.3 percent (grab sample) or 0.2 percent (integrated sample) indicate gas mixture was not thoroughly bubbled in reagents. Ask technician or crew leader when new reagents were added to apparatus.

(11) Check percent isokinetic.

(12) Inquire about the calibration history of the flow volume recorder. The flow measuring device is required to maintain an accuracy of ±5 percent over its operating range.

7.4 PERFORMANCE TEST DATA

The inspector must observe emitter operation and emission tests simultaneously to ensure that valid data are used in determining plant performance. The performance test checklist shown in Table 7.1 is based upon the observations described in Sections 7.1, 7.2, and 7.3. Suggested contents for stack test reports are given in Appendix E.

The reasons for having the inspector observe the test and complete the inspection sheet are twofold. First, emitter and control device parameters will serve as guidelines for future NSPS recordkeeping requirements; and second, the inspector's observation of a few major parameters ensures that the tests were properly conducted.

The emission testing firm is required to submit test reports to the facility and the control agency. Results from the testing firm must be carefully checked and compared with data from the inspector's form.

Table 7.1

NSPS INSPECTION CHECKLIST FOR SECONDARY BRASS AND BRONZE SMELTERS DURING PERFORMANCE TEST

Facility Name _____

Facility Address _____

Name of Plant Contact _____

Source Code Number _____

Unit Identification (To be tested) _____

Design Input Capacity _____ tons/day

Initial Start-up Date _____

Test Date _____

A. FACILITY DATA

Type	Furnace	No. of Furnaces _____
	Other	Specify _____
Charging Method	Batch	Continuous
Control Devices	Fabric Collector	Specify Type _____
	Scrubber	Specify Type _____
	Other	

Operating Schedule_____hrs/day_____days/wk_____wks/yr

B. OPERATING PARAMETERS

Data to Obtain During Performance Test[a]

Parameter	Clock Time
Charge Capacity	
Charge Rate	
Charge Copper Content	
Product Copper Content	
Period of Heat	
Oxygen Rate	
Compressed Air Rate	
Fuel Rate	
Pouring Temperature	

[a]Data should be recorded every 30 minutes

Table 7.1 (continued): NSPS INSPECTION CHECKLIST FOR SECONDARY BRASS AND BRONZE SHELTERS DURING PERFORMANCE TEST

C. PRETEST DATA (OBTAIN FROM TEST TEAM FIELD LEADER)

Test Company _____

Field Leader _____

Duct Dimensions_____in. x_____in.; Area _____ ft^2

Nearest Upstream Obstruction _____ ft

Nearest Downstream Obstruction _____ ft

No. of Sampling Ports _____

No. of Sampling Points _____

No. of Sampling Points Required From 40 CFR 60 _____

D. PARTICULATE PERFORMANCE TEST

Test No. _____ Start Time _____ Finish Time _____

Preliminary Traverse Run (Method 1)
Chosen Nozzle Diameter _____in.

Train Leak Check Yes_____ No_____

Opacity Readings Taken Yes_____ No_____

Moisture Determination (Method 4)
Percent Moisture
ml Collected/Gas Volume_____ml_____ ft^3
(or wet/dry bulb readings)

Combustion Gas Analyzer O_2 _____%
CO_2 _____%

Dry Gas Meter Reading Before Test _____ ft^3 at _____ (time)

Dry Gas Meter Reading After Test _____ ft^3 at _____ (time)

Volume Sampled _____ ft^3

Table 7.1 (continued). NSPS INSPECTION CHECKLIST FOR SECONDARY BRASS AND BRONZE SHELTERS DURING PERFORMANCE TEST

D. PARTICULATE PERFORMANCE TEST (continued)

Test Duration _____ minutes

Average Meter Orifice Pressure Drop _____ inches

Average Duct Temperature _____°F

Velocity Head at Sampling Point _____ inches H_2O

Meter ID _____

Repetition Start Time _____

Repetition Finish Time _____

E. CLEAN-UP PROCEDURE

Filter Condition	Dry		Wet
Probe Status	Unbroken		Broken
Glass Connectors	Unbroken		Broken
Clean-up Sample Spillage	None	Slight	Major
Sample Bottle Identification	Yes		No
Acetone Blank Taken	Yes		No

8.0 REFERENCES

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(6) Code of Federal Regulations. Title 40, Part 51 Revised as of July 1, 1976, General Services Administration, Washington, D.C. 1976.

(7) "Control Techniques for Particulate Air Pollutants," U.S. Department of Health, Education, and Welfare, Washington, D.C. January 1969.

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(19) Stern, A. C. "Air Pollution, Volume III, Sources of Air Pollution and Their Control." Academic Press, N.Y. 1968.

(20) Calvert, S."Systems Study of Scrubbers," Environmental Protection Agency, Research Triangle Park, N.C. 1972.

(21) Workshop on Stationary Source Enforcement, Engineering-Science, Inc., Washington, D.C. December 1974.

APPENDICES

APPENDIX A

STANDARDS OF PERFORMANCE FOR SECONDARY BRASS AND BRONZE INGOT PRODUCTION PLANTS

Chapter I - Environmental Protection Agency

SUBCHAPTER C - AIR PROGRAMS

PART 60 - STANDARDS OF PERFORMANCE
FOR NEW STATIONARY SOURCES

Subpart M - Standards of Performance
for Secondary Brass and Bronze Ingot Production Plants

§60.130 Applicability and designation of affected facility.

The provisions of this subpart are applicable to the following affected facilities in secondary brass or bronze ingot production plants: Reverberatory and electric furnaces of 1,000 kg (2,205 lb) or greater production capacity and blast (cupola) furnaces of 250 kg/hr (550 lb/hr) or greater production capacity.

§60.131 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Brass or bronze" means any metal alloy containing copper as its predominant constituent, and lesser amounts of zinc, tin, lead, or other metals.
(b) "Reverberatory furnace" includes the following types of reverberatory furnaces: Stationary, rotating, rocking, and tilting.
(c) "Electric furnace" means any furnace which uses electricity to produce over 50 percent of the heat required in the production of refined brass or bronze.
(d) "Blast furnace" means any furnace used to recover metal from slag.

§ 60.132 Standard for Particulate Matter

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall discharge or cause the discharge into the atmosphere from a reverberatory furnace any gases which:

(1) Contain particulate matter in excess of 50 mg/dscm (0.022 gr/dscf).

(2) Exhibit 20 percent opacity or greater.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall discharge or cause the discharge into the atmosphere from any blast (cupola) or electric furnace any gases which exhibit 10 percent opacity or greater.

§ 60.133 Test methods and procedures.

(a) The reference methods appended to this part, except as provided for in § 60.8(b), shall be used to determine compliance with the standards prescribed in § 60.132 as follows:

(1) Method 5 for the concentration of particulate matter and the associated moisture content.

(2) Method 1 for sample and velocity traverses.

(3) Method 2 for velocity and volumetric flow rate, and

(4) Method 3 for gas analysis.

(b) For Method 5, the sampling time for each run shall be at least 120 minutes and the sampling rate shall be at least 0.9 dscm/hr (0.53 dscf/min) except that shorter sampling times, when necessitated by process variables or other factors, may be approved by the Administrator. Particulate matter sampling shall be conducted during representative periods of charging and refining, but not during pouring of the heat.

APPENDIX B

METHOD 9 - VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FOR STATIONARY SOURCES

METHOD 9 - VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

[illegible] VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The method includes procedures for the training and certification of observers, and procedures to be used in the field for determination of plume opacity. The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this and is confirmed by field studies, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasty background, the apparent opacity of a plume is less and specific procedures as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under low contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (160 sets at a smoke generator), 16 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 12.5 percent opacity.

(2) For white plumes (110 sets at a smoke generator, 100 sets at a coal-fired power plant, and 349 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 35 percent were read with a positive error of less than 0 percent opacity.

The positive observational error associated with an average of respective readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. Principle and applicability.

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

2. Procedures. The observer qualified in accordance with paragraph 4 of this method shall use the following procedures for visually determining the opacity of emissions:

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g. roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time except when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g. stub stacks on baghouses).

2.2 Field records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, and the date on a field data sheet (Figure 9-1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded

[illegible]

[illegible] For a set, positive error/average opacity determined by observers' 25 observations; average opacity determined from transmissometer's 25 recordings.

[redacted]

[redacted]

[redacted]

[illegible] opacity of 0 percent and 100 percent. When static readings of 0 percent and 100 percent are noted, the smoke meter is adjusted to produce an output of 0 percent and 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

6.3.3 Smoke meter evaluation. The smoke meter design and performance are to be evaluated as follows:

6.3.3.1 Light source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ±5 percent of the nominal rated voltage.

6.3.3.2 Spectral response of photocell. Verify from manufacturer's data that the photocell has a spectral response to light wavelengths of the visible spectrum such that the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (A) of Table 6-1.

6.3.3.3 Angle of view. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of view, d = the sum of the photocell diameter plus the diameter of the limiting aperture, and L = the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator source meters this is normally an orifice plate.

6.3.3.4 Angle of projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of projection, d = the sum of the lengths of the lamp filament + the diameter of the limiting aperture, and L = the distance from the lamp to the limiting aperture.

6.3.3.5 Calibration error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 6.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter path-length. Filters calibrated within ±2 percent shall be used. Care should be taken when inserting the filters to prevent extraneous light from entering the meter. Take a total of five consecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

6.3.3.6 Rise and fall drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

6.3.3.7 Response time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach each opposite opacity value. The entire test sequence shall be performed in succession. Opacity values of 0 percent and 100 percent may be established by alternately switching the power to the light source off and on while the smoke generator is not operating.

6.4 References.

6.4.1 Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

6.4.2 Woodruff, Wayne I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, N.C., APTD-1100, August 1972, pp. 6.1-6.38.

6.4.3 Condon, E.U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., N.Y., N.Y., 1958, Table 6.1, p. 6-55.

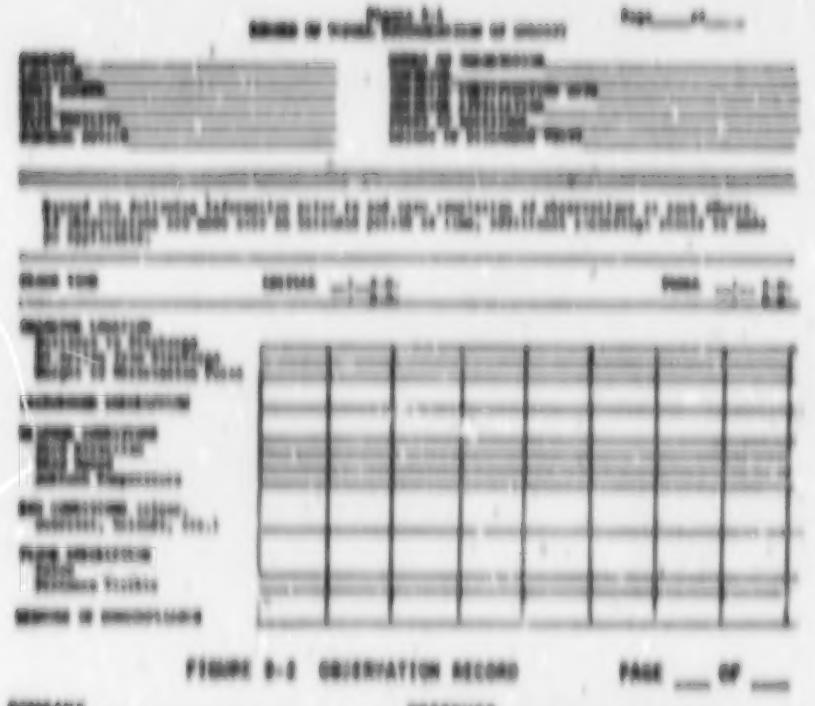
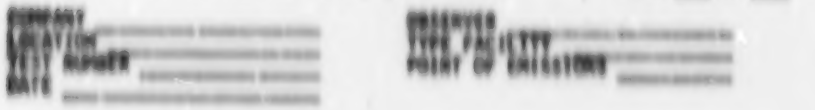


FIGURE B-2 OBSERVATION RECORD PAGE ___ OF ___



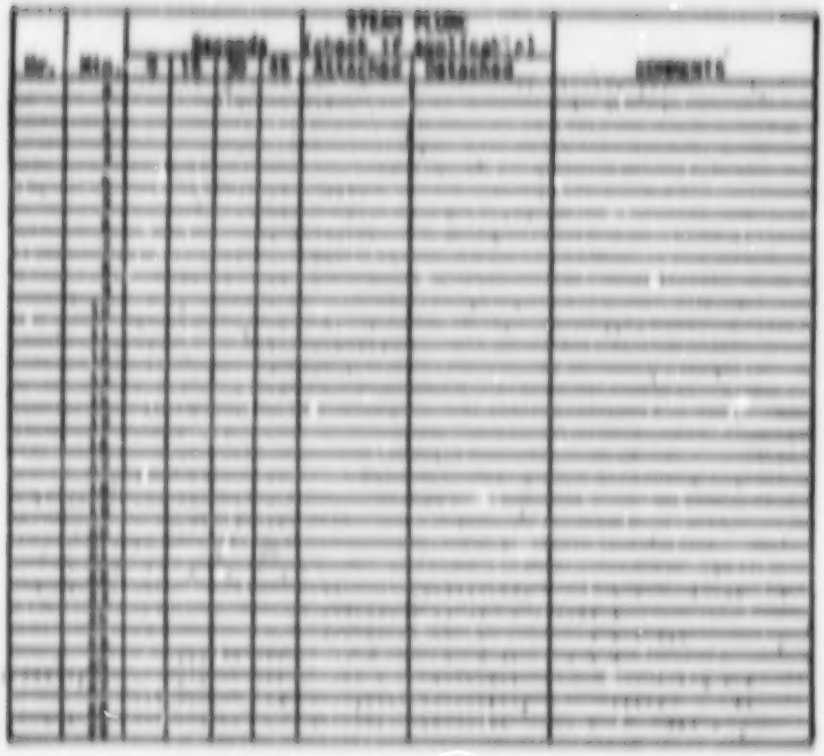


FIGURE 9-1 OBSERVATION RECORD (CONT.) PAGE ___ OF ___

COMPANY _____ OBSERVER _____
LOCATION _____ TYPE FAC (LIST) _____
TEST NUMBER _____ POINT OF EMISSIONS _____
DATE _____

HR.	MIN.	SECONDS 0 15 30 45	STEAM PLUME (check if applicable) PRESENT	COMPLIANCE	COMMENTS
	00				
	01				
	02				
	03				
	04				
	05				
	06				
	07				
	08				
	09				
	10				
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APPENDIX C

S 12. - GENERAL POLICY ON THE USE OF SECTION 114 AUTHORITY FOR ENFORCEMENT PURPOSES

§ 12. - GENERAL POLICY ON THE USE OF SECTION 114 AUTHORITY FOR ENFORCEMENT PURPOSES

INTRODUCTION

The purpose of this guideline is to provide guidance relating to the exercise of the authority set forth in Section 114 of the Clean Air Act, as amended, for enforcement purposes.1/

USES OF SECTION 114

Use in Determining Status of Compliance

Section 114(a)(1) provides that the Administrator may require the owner or operator of any source to provide information for the purpose of determining "whether any person is in violation of any such standard or any requirement of such a plan." This is one of the most important enforcement tools under the Clean Air Act, in that the source can be required to provide the information which may be the basis for enforcement action by EPA. Regions are urged to make extensive use of §114 for enforcement purposes since this is usually the most effective method of obtaining the necessary information to begin an enforcement action.

Uses During Emergency Episodes

Section 114(a)(iii) of the Act enables EPA to obtain information necessary to implement Section 303 authority (emergency episodes). During an emergency episode, it may be necessary to obtain recordkeeping by such owner or operator to ensure that he is taking appropriate action. This section can also be used to develop Section 303 emergency episode action plans, as discussed in General Enforcement Guideline 8.15.

1/ Section 114(a)(1) enables the Administrator to require owners or operators of emission sources "to (A) establish and maintain such records, (B) make such reports, (C) install, use, and maintain such monitoring equipment or methods, (D) sample such emissions (in accordance with such methods, at such locations, at such intervals, and in such manner as the Administrator shall prescribe), and (E) provide such other information, as he may reasonably require." Section 114(a)(2) authorizes right of entry for certain purposes and the right of the Administrator to sample emissions.

REQUEST FOR INFORMATION

Section 114 Letter Format

The letter to an owner or operator should recite expressly that it is being sent pursuant to Section 114(a)(ii) or (iii), state specifically the information required, recite the penalties for non-compliance, and specify a reasonable time to answer. Generally it should be sent certified mail, return receipt required, to document receipt. In the letter, the Regional Office may require the source owner or operator to appear at a designated time and place to discuss the information required to be provided to EPA.

During an emergency episode a Section 114 letter should be delivered personally to the source owner or operator and a receipt should be obtained upon delivery.

Privilege Against Self-Incrimination

A problem may arise in the case of an individual who refuses to provide information on the grounds of the Fifth Amendment privilege against self-incrimination. This is not a problem with respect to a corporation, since a corporation does not have this privilege. However, except as discussed in the following, an individual, as opposed to the corporation, may refuse to answer any request for information under Section 114 if the information might tend to incriminate him. (See OGC memo dated 8/7/73). If an individual refuses to comply with the request for information on this ground, the Regional Office should consider itself on notice of a probable violation and should gather the information by other methods.

If the information needed from the source owner or operator is required to be kept under a recordkeeping provision of a State Implementation Plan, then the privilege may not be invoked, even by an individual. 1/ Thus, if an individual raises an objection on Fifth Amendment grounds, the State Implementation Plan should be checked to determine whether the plan requires such information to be kept by the source, and if it does, Fifth Amendment objections are not valid and the information must be provided.

1/ According to the Shapiro Doctrine, "the privilege which exists as to private papers cannot be maintained in relation to 'records required by law to be kept in order that there may be suitable information of transactions which are the subject of governmental regulations and the enforcement of restrictions validly established'".

The Section 114 letter need not call to the attention of the source owner or operator that he may have a right to invoke the privilege against self-incrimination nor need this be done at an onsight investigation. The Miranda warning is required only where a person is "in custody".

Federal Reports Act

Section 114 letters sent to persons suspected of being in violation of an implementation plan requirement or Section 303 are not subject to the Federal Reports Act. Identical letters may be sent to multiple sources without the need for securing OMB approval since this use of Section 114 is an enforcement function rather than the gathering of technical data for standard setting purposes.

Before sending out a Section 114 letter, check the NEDS data bank to determine whether EPA already has such information. However, where immediate enforcement action is contemplated, the Regional Offices should direct a Section 114 letter to the source regardless of the results secured from the data bank. Duplication of reported information can be avoided by advising the source of the information in our possession and affording the source the opportunity to confirm such information as responsive to the Section 114 inquiry. This practice will be necessary because information employed for enforcement purposes must constitute reliable evidence on the present status of compliance and be so represented by the source under pain of penalty for any misrepresentation. To proceed otherwise presents the prospect that a source may repudiate information in our possession on which we base a finding of violation, and we then would be forced to gather further proof to verify and substantiate our determination before commencement of any judicial proceedings.

Trade Secrets

It is anticipated that some of the information required by Section 114 letters will contain trade secrets. Although the information asked for must be provided, the source owner or operator can designate certain portions of his response confidential and EPA must treat it as such unless and until the Administrator determines that it is not entitled to protection as a trade secret. This determination should be made after the information has been submitted, if either the source owner or operator requires that such a determination be made or if someone else requests the information from EPA. Regional Offices can also make these determinations on their own initiative to keep down the amount of material which must be afforded confidential treatment. No determination or agreement will be made concerning trade secrets status prior to receipt of the

Section 114 information. The regulations in 40 CFR Part 2 outline the EPA procedures for making this determination.

ENTRY AND INSPECTION

Section 114(a)(2) enables the Administrator or his authorized representative to enter a source so that EPA can do its own monitoring, sampling, inspecting or copying of records. This authority also can be used to determine whether a source is carrying out any obligations imposed on it by EPA under Section 114(a)(1).

The term "authorized representative" would include specific individuals from each Regional Office, preferably permanently designated to give a sense of continuity and familiarity with the tasks. This does not mean that other Regional Office or EPA employees cannot perform such tasks on an ad hoc basis when necessary to achieve EPA objectives.

A contractor for EPA or other person assisting EPA in carrying out its functions may be designated as an "authorized representative" for specific purposes which should be stated in a letter granting such representative status to the contractor. However, if the contractor is refused entry by the source owner or operator despite this letter, it is not advisable to request a U.S. Attorney to obtain a search warrant to gain entry for the contractor, since a judge would most likely refuse to issue one. EPA personnel should perform the task themselves if such a situation arises or accompany the EPA contractor performing the work.

Where a state has been delegated Section 114 authority from EPA, the same authority EPA has to monitor, sample, inspect or copy records, and any other authority under Section 114(a)(1) and (2) of the Clean Air Act can, in like manner be exercised by the State. No representative of EPA need accompany the state officials.

Section 114(a)(2) requires that the person exercising the right of entry should have credentials. EPA has established a procedure governing issuance and control of credentials. Regional Offices may obtain such credentials in accordance with the procedures. The Regional Offices can still issue their own credentials to carry out Section 114 in the period until the procedures in the EPA order can be implemented or in unusual circumstances. If the Regional Office chooses to issue its own credentials in such instances, such credentials should contain the agency name; the bearers name, signature, and photograph; the division in the agency with which he is employed; the quotation of Section 114 authority under which entry is sought; and a

citation of the penalties for noncompliance with Section 114. The credentials should be signed by the Regional Administrator. Credentials can also be issued by the Regional Office in the form of a letter on an ad hoc basis where there is not sufficient time to obtain more permanent credentials. The letter should contain all of the information that is in the permanent credentials except the photograph and signature of the bearer.

Entry for Section 114 purposes should be confined, except in emergencies, to normal business hours to minimize inconvenience to the source.

Safety Equipment

A source owner or operator has no responsibility to supply EPA inspection teams exercising Section 114 authority with safety equipment such as hard hats or shoes. EPA should provide whatever equipment is necessary for an inspection team to safely perform those duties encrusted to them by law.

Visitors Releases

Members of inspection teams exercising Section 114 authority should not sign waivers or "visitors releases" that would absolve the company of responsibility of injury due to negligence. In a memo to all Regional Counsels dated November 8, 1972, from John Quarles, it is stated that "Inasmuch as the Clean Air Act . . . grant(s) EPA employees a right of entry to corporate facilities, a company may not lawfully condition the exercise of this right upon the signing of a release or indemnity agreement." "When a firm refuses entry to an EPA employee performing his function under the Clean Air Act, the employee may appropriately cite the statute and remind the company of EPA's right to seek judicial enforcement. If the company persists in its refusal, EPA should go to court in preference to signing a 'Visitors Release'".

Search Warrants

If a source owner or operator refuses to admit EPA authorized representatives attempting to exercise Section 114 responsibilities, entry cannot be made until a search warrant is obtained. Appropriate Regional personnel should be notified so that they can request that the U.S. Attorney obtain a search warrant. (OGCE is developing a model application for a search warrant and a model search warrant for use by the Regional Offices). If any delay is anticipated from a source in permitting the exercise of Section 114 authority and such delay is unacceptable to the successful completion of EPA tasks, a

search warrant should be obtained. If delay is anticipated even with a search warrant, it can be requested that the search warrant be written so that immediate entry be granted.

ENFORCEMENT PROCEDURES

Section 113(a)(3) provides that if the Administrator finds that any person is in violation of any requirement of Section 114, he may bring a civil action or issue an administrative order. Guideline 84, outlines procedures relevant to the commencement of a civil action or issuance of an administrative order.

In cases of failure to comply with Section 114, issuance of an administrative order is more appropriate. However, in most cases regional enforcement personnel will want to phone the source prior to the issuance of such an order to determine the reasons for the source owner or operator's failure to comply. If the source owner or operator continues his refusal to comply after the phone call, issuance of the order should proceed. The order should include a final date for compliance, and should specify a date for an opportunity to confer pursuant to Section 113(a)(4) prior to the effective date of the order. If the source owner or operator violates the order, civil and criminal action will then be appropriate.

While there are no criminal penalties for refusing to comply with Section 114 per se, a knowing failure to comply with any order issued under Section 113 relating to a Section 114 violation would subject the violator to criminal penalties of up to $25,000 per day or imprisonment for not more than one year, or both, for the first offense. Criminal penalties are also appropriate in the case of any person who knowingly makes any false statement or tampers with any monitoring device. The criminal penalties specified in Section 113(c)(2) for a violation of this type are a fine not to exceed $10,000 or imprisonment for not more than six months, or both. (See Guideline 8.0, General Policy on Commencement of Criminal Actions Pursuant to Section 113(c)).

APPENDIX D

SUGGESTED CONTENTS OF STACK TEST REPORTS

CONTENTS OF STACK TEST REPORTS

In order to adequately assess the accuracy of any test report the basic information listed in the following suggested outline is necessary:

(1) Introduction. Background information pertinent to the test is presented in this section. This information shall include, but not be limited to, the following:
   (a) Manufacturer's name and address.
   (b) Name and address of testing organization.
   (c) Names of persons present, dates and location of test.
   (d) Schematic drawings of the process being tested showing emission points, sampling sites, and stack cross-section with the sampling points labeled and dimensions indicated.
   (e) Brief process description.

(2) Summary. This section shall present a summary of test findings pertinent to the evaluation of the process with respect to the applicable emission standard. The information shall include, but not be limited to, the following:
   (a) A summary of emission rates found.
   (b) Isokinetic sampling rates achieved if applicable.
   (c) The operating level of the process while the tests were conducted.

(3) Procedure. This section shall describe the procedures used and the operation of the sampling train and process during the tests. The information shall include, but not be limited to, the following:
   (a) A schematic drawing of the sampling devices used with each component designated and explained in a legend.
   (b) A brief description of the method used to operate the sampling train and procedure used to recover samples.

(4) Analytical Technique. This section shall contain a brief description of all analytical techniques used to determine the emissions from the source.

(5) Data and Calculations. This section shall include all data collected and calculations. As a minimum, this section shall contain the following information:
   (a) All field data collected on raw data sheets.
   (b) A log of process and sampling train operations.

(c) Laboratory data including blanks, tare weights, and results of analysis.
(d) All emission calculations.

(6) Chain of Custody. A listing of the chain of custody of the emission test samples.

(7) Appendix:

(a) Calibration work sheets for sampling equipment.
(b) Calibration or process logs of process parameters.

APPENDIX B

BRASS AND BRONZE INGOT INSTITUTE
LIST OF STANDARD COPPER BASE ALLOYS

Figure No.	Casting Method	CDA	ASTM	ASME	SAE	AMS	Federal	Military
101	Centrifugal	862	*	*	*	*	QQ-C-390	*
	Continuous	862	B505	*	*	*	QQ-C-390	*
	Ingot	862	B30	*	*	*	*	*
	Sand	862	*	*	*	*	QQ-C-390	*
110	Centrifugal	836	B271	SB271	CAB36	4855	QQ-C-387	MIL-C-15345, Alloy 1
	Continuous	836	B505	*	CAB36	4855	QQ-C-390	*
	Ingot	836	B30	*	*	*	*	*
	Investment	836	*	*	CAB36	*	*	MIL-C-22057, Comp. 1
	Permanent	836	*	*	*	*	*	MIL-C-11868, Comp. 11
	Sand	836	B62 B584 (Formerly B145)	SB62	CAB36	4855	QQ-C-390	MIL-C-22229, Comp. 1
120	Centrifugal	838	B271	*	*	*	QQ-C-390	*
	Continuous	838	B505	*	*	*	QQ-C-390	*
	Ingot	838	B30	*	*	*	*	*
	Sand	838	B584 (Formerly B145)	*	*	*	QQ-C-390	*
133	Centrifugal	844	B271	*	*	*	*	*
	Continuous	844	B505	*	*	*	QQ-C-390	*
	Ingot	844	B30	*	*	*	*	*
	Sand	844	B584 (Formerly B145)	*	*	*	QQ-C-390	*
155	Sand	865	*	*	*	*	*	*

Ingot No.	Casting Method	CDA	ASTM	ASME	SAE	AMS	Federal	Military
190	Centrifugal	810	B271	x	x	x	x	x
	Continuous	810	B505	x	x	x	x	x
	Ingot	810	B30	x	x	x	x	x
	Sand	810	B584 (Formerly B-143)	x	x	x	x	x
191	Sand	830	x	x	x	x	x	x
194	Centrifugal	913	x	x	x	7333	QQ-C-390	x
	Continuous	913	B505	x	x	7333	QQ-C-390	x
	Ingot	913	680	x	x	x	x	x
	Sand	913	888	x	x	7333	QQ-C-390	x
197	Centrifugal	910	x	x	x	x	QQ-C-390	x
	Continuous	910	B505	x	x	x	QQ-C-390	x
	Ingot	910	830	x	x	x	x	x
	Sand	910	x	x	x	x	Q-C-390	x
199	x	909	x	x	x	x	x	x
200M	Continuous	905	B505	x	x	x	x	x
	Ingot	905	B30	x	x	x	x	x
	Sand	905	x	x	40905	x	x	x
895	Centrifugal	897	x	x	x	x	x	x
	Continuous	897	B505	x	x	x	QQ-C-390	x
	Ingot	897	830	x	x	x	x	x
	Sand	897	x	x	40907	x	x	x

Basic No.	Casting Method	CDA	ASTM	SAE	AA	AMS	Federal	Mil/Spec
8500	Centrifugal	918	B427	x	x	x	QQ-C-390	MIL-C-11345, Alloy 83
	Continuous	918	x	x	x	x	x	x
	Sand	918	B427	x	x	x	x	x
850	Continuous	937	B505	x	C84B37	x	x	x
	Ingot	937	B30	x	x	x	x	x
	Sand	937	x	x	C84B37	x	x	x
810	Centrifugal	905	B271	x	C84B05	4843	QQ390	x
	Continuous	905	B22, B505	x	C84B05	4843	QQ-C-390	x
	Ingot	905	B30	x	x	x	x	x
	Sand	905	B22, B584 (Formerly B143)	x	C84B0	4848	QQ-C-390	x
818	Sand	906	x	x	x	x	x	x
835	Centrifugal	903	B271	x	C84B03	x	QQ-C-390	MIL-C-11343, Alloy 8
	Continuous	903	B505	x	C84B03	x	QQ 390	x
	Ingot	903	B30	x	C84B03	x	x	x
	Investment	903	x	x	C84B03	x	x	MIL-C-11087, Comp. 3
	Precision	903	x	x	C84B03	x	x	MIL-C-11040, Comp. 3A
	Sand	903	B584 (Formerly B143)	x	C84B03	x	x	MIL-C-22229, Comp. 1

Legacy No.	Casting Method	CDA	ASTM	ASME	SAE	AMS	Federal	Military
090	Centrifugal	903	B271	-	C64200	-	QQ-C-390	MIL-B-16166, Alloy 10
	Continuous	903	B505	-	C64200	-	QQ390	-
	Ingot	903	B30	-	-	-	-	-
	Sand	903	B584 (Formerly B143)	-	C64200	-	QQ-C-390	-
012	-	902	-	-	-	-	-	-
065	Centrifugal	922	B271	B271	C69400	-	QQ-C-390	MIL-C-15345, Alloy 9 MIL-B-16541
	Continuous	922	B505	-	C69400	-	QQ-C-390	MIL-B-16541
	Ingot	922	B30	-	-	-	-	-
	Permanent Mold	922	-	-	C69400	-	-	-
	Sand	922	B61 B584 (Formerly B143)	B61	C69400	-	QQ-C-390	MIL-B-16541
055	Sand	-	-	-	-	-	-	-
095	Continuous	908	B505	-	-	-	-	-
	Ingot	908	B30	-	-	-	-	-
	Sand	908	-	-	-	-	-	-
005	Centrifugal	937	B271	B271	C86300	4860	-	-
	Continuous	937	B505	-	C86300	-	QQ-C-390	-
	Ingot	937	B30	-	-	-	-	-
	Sand	937	B584 (Formerly B144)	-	C86300	4860	QQ-C-390	-

Specification No.	Casting Process	ISO	ASTM	ASME	SAE	AMS	Federal	Military
311	Centrifugal	936	*	*	*	*	QQ-C-390	MIL-C-19345, Alloy 11
	Continuous	936	A888	*	*	*	QQ-C-390	*
	Ingot	936	*	*	*	*	*	*
	Investment	936	*	*	*	*	*	MIL-C-23097, Comp. 1
	Sand	936	*	*	*	*	QQ-C-390	MIL-C-22709, Comp. 1
319	Sand	946	888	*	*	*	*	*
313	Centrifugal	933	8871	*	68933	*	QQ-C-390	MIL-C-19345, Alloy 13
	Continuous	933	8803	*	68933	*	QQ-C-390	*
	Ingot	933	833	*	*	*	*	*
	Permanent Mold	933	*	*	68935	*	*	*
	Sand	933	8184 (Formerly 8554)	*	68933	*	QQ-C-390	*
318	Centrifugal	938	8871	*	*	*	QQ-C-390	*
	Continuous	938	8803	*	*	*	QQ-C-390	*
	Ingot	938	838	*	*	*	*	*
	Sand	938	888 8184 (Formerly 8554)	*	*	*	QQ-C-390	*
301	Sand	913	888	*	*	*	*	*

Ingot No.	Casting Method	CDA	ASTM	ASME	SAE	AMS	Federal	Military
305	Centrifugal	943	B271	*	*	*	QQ-C-390	*
	Continuous	943	B505	*	*	*	QQ-C-390	*
	Ingot	943	B30	*	*	*	*	*
	Sand	943	B66 B584 (formerly B144)	*	*	*	QQ-C-390	*
315	Ingot	941	B30	*	*	*	*	*
	Sand	941	B67	*	*	*	*	*
356	Centrifugal	935	B271	*	JA935	*	QQ-C-390	*
	Continuous	935	B505	*	CA935	*	QQ-C-390	*
	Sand	935	B584 (formerly B144)	*	CA935	*	QQ-C-390	*
400	Ingot	852	B30	*	*	*	*	*
	Sand	852	B584 (formerly B148)	*	*	*	QQ-C-390	*
404	Ingot	854	B30	*	*	*	*	*
	Sand	854	B584 (formerly B148)	*	*	*	QQ-C-390	*
405.1 406	Die	858	B176	*	*	*	*	MIL-B-16804, Class 1
405.2 406	Centrifugal	857	B271	*	*	*	QQ-C-390	MIL-C-19345, Alloy 3
	Ingot	857	B30	*	*	*	*	*
407	Various	858	*	*	*	*	*	*

(c) Laboratory data including blanks, tare weights, and results of analysis.
(d) All emission calculations.

(6) Chain of Custody. A listing of the chain of custody of the emission test samples.

(7) Appendix:

(a) Calibration work sheets for sampling equipment.
(b) Calibration or process logs of process parameters.

Ingot No.	Casting Method	CDA	AQTH	ASMB	SAE	ANS	Federal	Military
607.5	Centrifugal	836	*	*	*	*	*	MIL-B-16393
610	Centrifugal	973	B271	*	*	*	*	*
	Sand	973	B584 (formerly B148)	*	*	*	*	*
611	*	976	*	*	*	*	*	*
612	Centrifugal	976	B271	SB271	*	*	*	*
	Sand	976	B584 (formerly B148)	SB584	*	*	*	*
613A	Centrifugal	978	B271	*	*	*	*	*
	Sand	978	B584 (formerly B148)	*	*	*	*	*
615	Centrifugal	952	B271	SB271	CA952	*	(QQ)-C-390	*
		953	B271	*	CA953	*	(QQ)-C-390	*
		954	B271	SB271	*	*	(QQ)-C-390	MIL-C-15345, Alloy 13
615D		955	B271	*	*	*	(QQ)-C-390	MIL-C-15345, Alloy 14
615D		958	B271	*	*	*	(QQ)-C-390	*
	Continuous	952	B505	*	*	*	*	*
		953	B505	*	*	*	*	*
		954	B505	*	*	*	*	*
615D		955	B505	*	*	*	*	*
	Ingot	952	B505	*	*	*	*	*
		953	B30	*	*	*	*	*
		954	B30	*	*	*	*	*
615D		955	B30	*	*	*	*	*
615D	Investment	955	*	*	*	*	*	MIL-C-22087, Comp. B
	Precision	953	*	*	CA953	*	*	MIL-C-11866, Comp. 23
	Sand	955	B148	*	CA955	*	(QQ)-C-390	MIL-C-22229, Comp. 1

Ingot No.	Casting Method	CDA	AESTM	ASME	SAE	AMS	Federal	Military
615 (cont'd)	Sand (cont'd)	953	B148	*	CA953	*	QQ-C-390	*
		954	B148	*	*	*	QQ-C-390	*
623D		955	B148	*	*	*	QQ-C-390	MIL-C-22229, Comp. B
		956	B148	*	*	*	QQ-C-390	MIL-B-24480
650	Centrifugal	864	B271	*	*	*	*	*
	Continuous	864	B505	*	*	*	*	*
	Ingot	864	B30	*	*	*	*	*
	Sand	864	B584 (formerly B147)	*	*	*	QQ-C-390	*
651	Centrifugal	865	B271	*	CA865	4860	QQ-C-390	MIL-C-15345, Alloy 6
	Ingot	865	B30	*	*	*	*	*
	Investment	865	*	*	CA865	*	*	*
	Sand	865	B584 (formerly B147)	*	CA865	4860	QQ-C-390	MIL-C-22229, Comp. 7
655	Centrifugal	867	B271	*	*	*	*	*
	Ingot	867	B30	*	*	*	*	*
	Sand	867	B584 (formerly B137)	*	*	*	*	*
673	Centrifugal	881	*	*	*	*	QQ-C-390	MIL-C-15345, Alloy 1
		881	B505	*	*	*	*	*
	Continuous	881	B505	*	*	*	*	*
	Ingot	881	B30	*	*	*	*	*
	Investment	881	*	*	*	*	*	MIL-C-22067, Comp. 1
		881	*	*	CA881	*	*	MIL-C-22067, Comp. 8

Ingot No.	Casting Method	CDA	ASTM	ASME	SAE	AMS	Federal	Military
433 (Cont'd)	Precision	863	*	*	*	*	*	MIL-C-11866, Comps. 2B and 3C
	Sand	863	B584 (formerly B147)	*	CA863	*	QQ-C-390	MIL-C-22229, Comps. 9 and 10
434	Centrifugal	863	B271	*	CA863	4863	QQ-C-390	MIL-C-15345, Alloy 8
	Continuous	863	B505	*	*	*	*	*
	Ingot	863	B30	*	*	*	*	*
	Investment	863	*	*	CA863	*	**	MIL-C-22087, Comp. 9
	Precision	863	*	*	*	*	*	MIL-C-11866, Comp. 3C
	Sand	863	B22, B584 (formerly B147)	*	CA863	4863	QQ-C-390	MIL-C-22229, Comp. 8
500	Centrifugal	873	B271	*	*	*	QQ-C-390	*
500-138		874	B271	*	*	*	QQ-C-390	*
500-138		875	B271	*	*	*	*	*
500-138	Die	878	B176	*	*	*	*	MIL-B-11804, Class 3
	Ingot	873	B30	*	*	*	*	*
500-138		874	B30	*	*	*	*	*
500-138		875	B30	*	*	*	*	*
		876	B30	*	*	*	*	*
500-138	Investment	875	*	*	*	*	*	MIL-C-22087, Comp. 4
	Precision	873	*	*	*	*	*	MIL-C-11866, Comp. 1B
	Sand	873	B584 (formerly B138)	*	*	*	QQ-C-390	MIL-C-22229, Comp. 3
500-138		876	B584 (formerly B-138)	*	*	*	QQ-C-390	*

Amount per	Cleaning Method	CRA	ASTM	AOAC	OAB	AOC	Federal	Military
500 (Cont'd)	Sand (Cont'd)	875	D1004 (formerly D1003)	*	*	*	CCC-C-390	*
		876	D1044 (formerly D1003)	*	*	*	*	*